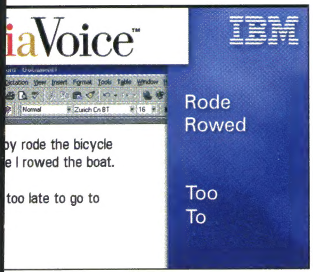
ELECTRONICS
and Beyond

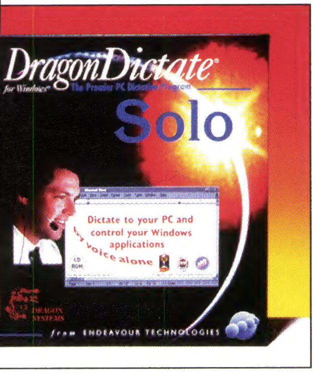
G G 26089
BRENTFORD SQUARE
NEWS PH 9878 1882
39 02$ 9.25

p://www.maplin.co.uk

JULY 1998 NO. 127 £2.65


iaVoice
IBM
y rode the bicycle
e I rowed the boat.
too late to go to
Rode
Rowed
Too
To

oice ecognition oftware eview


DragonDictate
for Windows
Solo
Dictate to your PC and control your Windows applications
by voice alone
from ENDEAVOUR TECHNOLOGIES

ROJECTS

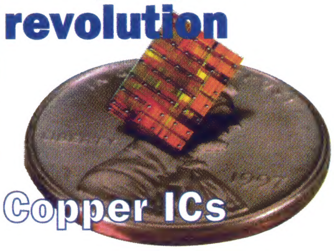
18MHz iniature ansmitter receiver

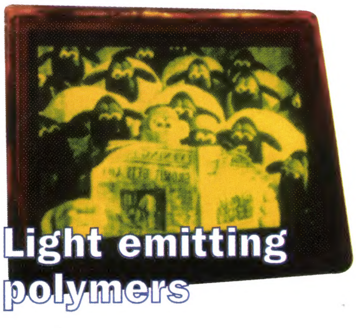
ntelligent attery harger

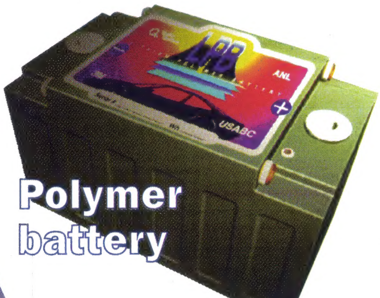
MAPLIN
ELECTRONICS

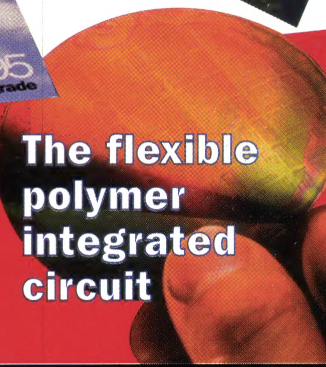
Building a PC
Loading the software

From copper to plastic - The polymer revolution


Copper ICs


Light emitting polymers


Polymer battery


The flexible polymer integrated circuit

ritain's most widely circulated magazine for electronics!

BACK ISSUES
Never leave home without them

Back issues are available at all Maplin Stores or by mail order. Only £2.65 each.
Call the Sales Hotline on 01702 554000 and include them in your order.

Issue 122 • Order as XD22Y	Issue 123 • Order as XD23A	Issue 124 • Order as XD24B	Issue 125 • Order as XD25C	Issue 126 • Order as XD26D
PROJECTS Recording LPs onto CDs ★ Video Distribution Amplifier Case **FEATURES** Electronics in Agriculture ★ Gravitational Waves ★ The El Niño Effect ★ CB Radio Abuse ★ Radio Communications Products **REVIEW** Nuts & Bolts	**PROJECTS** Recording LPs onto CDs ★ Sentinel Fan Failure Alert ★ Model Speed Controller ★ Loudspeaker Protector **FEATURES** Analogue or Digital? ★ The Mysteries of Neptune ★ Getting Onto the Internet Pt3 ★ Dairy Farming **REVIEW** Radio Communications	**PROJECTS** Recording LPs onto CDs ★ Time/Date Stamp ★ Building PCs ★ IBUS Control Module **FEATURES** Analogue or Digital? Pt2 ★ Sounds of Nature ★ Getting Onto the Internet Pt4 ★ Dairy Farming **REVIEW** Radio Communications	**PROJECTS** Midi Thru' Box ★ On Screen Video Meter ★ Building PCs ★ IBUS Analogue Output Module **FEATURES** Market Futures ★ Get more from Visual Basic ★ Getting Onto the Internet Pt5 ★ Static ★ Crouzet Solid State Relays	**PROJECTS** Basic Power Supply ★ Building PCs ★ On Screen Video Meter ★ IBUS Output Module **FEATURES** Thermal Imaging ★ Radioactivity ★ Sound Card Technology ★ Weighing Technology **REVIEW** Radio Communications

THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

July 1998 Vol. 17 No. 127

Projects

8 **Building & Upgrading PCs**
In part 4, Mark Brighton loads the necessary software to produce a working machine.

13 **418MHz Tx/Rx Modules – Part 1 Projects & Applications**
Maplin have introduce a low-cost pair of modules, Gavin Cheeseman describes the circuits and applications.

26 **Transistor Tester**
Godfrey Manning describes a simple, but effective piece of test gear.

32 **Intelligent Battery Charger**
Mike Roberts describes a sophisticated NiCd charger that will monitor the state of your batteries.

62 **IBUS Applications**
Neil Johnson describes how to put your collection of IBUS modules to good use.

Features

17 **Calling All Cards**
Alan Simpson looks at payphones and cards – past and present – plus a chance to win some New World payphone cards.

22 **Weighing Technology: Past and Present**
In this final part, Douglas Clarkson looks at the latest technology in weighing.

28 **Sound Card Technology**
In this second part, Mike Bedford analyses typical specifications.

39 **Conversing with Computers**
Stephen Waddington compares two rival speech recognition packages for the PC with surprising results!

44 **Radioactivity: A Century of Controversy**
In this second instalment Greg Grant discusses natural radiation.

48 **Get More From Visual Basic – Part 4**
Mike Holmes covers Visual Basic for DOS in his continuing series.

52 **Research News**
Researchers in Germany have developed a novel way to produce internal 3D sculpturing using sub-surface laser engraving.

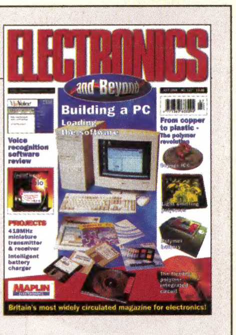
54 **Back to the Future**
Stephen Waddington looks at the advances in polymer technology and copper connections in the next generation microprocessors.

59 **Spreadsheets for Engineers & Scientists**
Mike Bedford explains how to push the humble spreadsheet to the limits.

66 **Security Electronics Systems Part 10**
In this final part, Ray Marston describes a collection of electronic circuits for your car.

Regulars

2 **News Report**
20 **ScienceLine Q&A**
42 **What's On & Diary Dates**
43 **Air Your Views**
72 **Technology Watch**
74 **@Internet**
79 **In the Pipeline**
80 **How to Subscribe**


ELECTRONICS
and Beyond
Building a PC
Loading the software
From copper to plastic - The polymer revolution
Voice recognition software review
PROJECTS
418MHz miniature transmitter & receiver
Intelligent battery charger
MAPLIN
Britain's most widely circulated magazine for electronics!

Cover pictures: ©Copyright 1998 Maplin Electronics PLC, All rights reserved.

Editorial
Editor Paul Freeman-Sear BSc (Hons)
Technical Author John Mosely
Editorial Assistant Lynda Hardy
News Editor Stephen Waddington BEng (Hons)
Technical Illustration Set Square Designs

Production
Design Layout Artist Karen Harris
Photography Librarian Mavis Williams
Published by Maplin Electronics plc.,
P.O. Box 777, Rayleigh, Essex, SS6 8LU.
Tel: (01702) 554155.
Fax: (01702) 554001.
Lithographic Reproduction by Planagraphic Studios,
18 Sirdar Road, Brook Road Ind. Estate, Rayleigh, Essex SS6 7UY.
Printed by Millennium Web Offset plc.,
Penryn, Cornwall, TR10 9EP

Management
Manager
Paul Freeman-Sear BSc (Hons)
Marketing Services Manager
Steve Drake

Subscriptions
Maureen Harvey
Tel: (01702) 554155 Ext. 311.

Advertising and Circulation
In association with Fox Publishing
135 Greenford Road, Sudbury Hill, Harrow, Middlesex, HA13YD.
Tel: 0181 869 8410

UK Newstrade Distribution
Maplin Elecronics PLC.

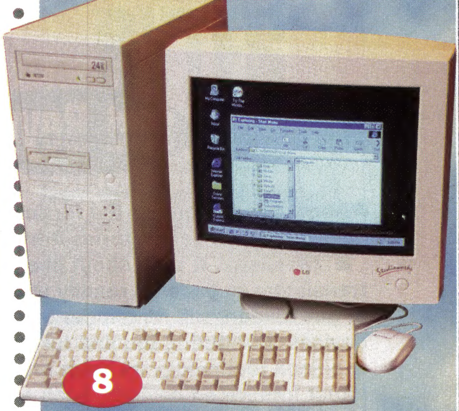
Copyright 1998 Maplin Electronics PLC.

Copyright: All material is subject to worldwide copyright protection, and reproduction or imitation in whole or part is expressly forbidden. Permission to reproduce printed circuit board layouts commercially or marketing of kits must be sought from the publisher.

Advertisements: Whilst every reasonable precaution is undertaken to protect the interests of readers by ensuring, as far as possible, that advertisements appearing in the current issue of *Electronics and Beyond* are bona fide, the publisher and staff of the magazine cannot give any undertakings in respect of statements or claims made by advertisers, whether on printed page or on loose insert. Readers who have reasonable grounds to believe that they have been misled are advised to contact their local Trading Standards Office.

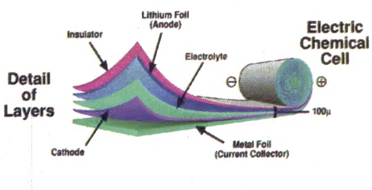
Editorial: The views of individual contributors/authors are not necessarily those of either the publisher or the editor. Where errors occur corrections will be published as soon as possible afterwards.

Publisher's Statement: Maplin Electronics PLC., take all reasonable care to prevent injury, loss or damage of any kind being caused by any matter published in *Electronics and Beyond*. Save in so far as prohibited by English law, liability of every kind including negligence is disclaimed as regards any person in respect thereof.

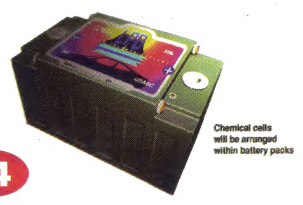


The Lithium Polymer Battery (LPB) Concept

Jelly Roll Design



LPB Battery Pack



NEWS BYTES

Sun and IBM to Develop Java-Based Operating System

Sun and IBM have agreed to work together to develop a new operating system based on Java. The new system would be targeted for use in dumb terminals. The two computer makers also plan to license the new Java OS to other companies.

For further information, check: `www.sun.com`.

Contact: Sun, Tel: (01276) 20444.

NCs Lose Market Share To Low Cost PCs

Network computers haven not made the big splash many in the industry expected, largely due to the appearance of a new breed of Windows-based PCs, which are thinner and cheaper than NCs. IDC predicts that by 2002, these slimmed-down PCs will dominate 75% of the market for less expensive business computing alternatives.

That estimate is bad news for Sun Microsystems and Oracle, which embraced the network computer concept, but were unable to build the machines in time to stave off the shift to cheaper PCs.

For further details, check: `www.idc.com`.

Contact: IDC, Tel: (0181) 987 7100.

Used PC Market up 14%

The market for recycled PCs is up 14% this year, according to research by IDC, with most of the growth in the education and small business sectors, where budgets are often tight. IDC expects the market to continue its upward spiral, from 6.4,000,000 units this year to 7.3,000,000 in 1999.

For further details, check: `www.idc.com`.

Contact: IDC, Tel: (0181) 987 7100.

Microsoft and Sony Form PC TV Alliance

Microsoft and Sony have agreed to incorporate each other's technologies in both companies' products, in an effort to achieve the convergence of PC and television technologies. Sony has agreed to license Microsoft's Windows CE operating system. In return, Microsoft will license Sony's Home Networking Module.

For further details, check: `www.microsoft.com`.

Contact: Microsoft, Tel: (0345) 002000.

LSI & Bosch Breaks FM Sound Barrier

LSI Logic and Bosch have announced a single-chip joint development of a single-chip digital radio system that is at the heart of Bosch's recently-announced Digital Audio Broadcasting (DAB) Module and digital car radios.

For further information, check: `www.lsil.com`.

Contact: LSI Logic, Tel: (01344) 426544.

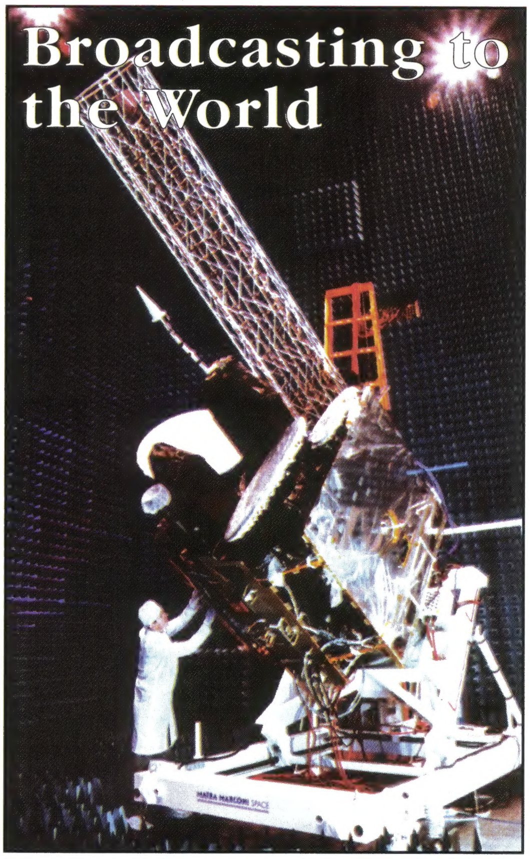
Mauritron Release Technical Manuals on CD-ROM

Mauritron Technical Services is the UKs major supplier of service manuals for a wide range of electronic equipment from the earliest valve equipment to the latest video recorders etc, and now supply technical manuals as compilations on CD-ROM. Each CD-ROM contains 25 service manuals for a comprehensive selection of equipment that the busy service department or hobbyist is likely to come across. Each CD is £24.95 plus VAT, with the current range covering television, video recorders, computer monitors etc., and future editions covering test equipment, amateur radio, office equipment and much more.

For further details and offers check `http://www.mauritron.co.uk/mauritron/`

Contact: Mauritron Technical Services, Tel: (01844) 351694

Broadcasting to the World



Alcatel Espace of Toulouse has designed and built three satellites for the WorldSpace Digital Sound Broadcasting System. The system is a world first and will provide vast areas of the developing world with high quality services including radio broadcasts, multimedia, and transmission of still and moving images such as maps and weather information.

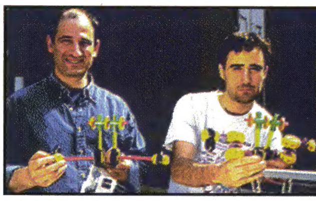
The system routes signals from ground contro station via a small satellite dish to a geostationa satellite where the signals can then be picked u directly by portable receivers. The system will eventually be available in Africa, the Middle East Asia, the Mediterranean basin, Latin America and the Caribbean. The small receivers will be able to pick up over a 100 radio stations with CD sound quality.

Alcatel Espace is providing the three geostationary satellites – AfriStar, CaribStar and AsiaStar – along with the ground control systems. Each satellite will have on-board baseband processing for more efficient 'bundling and routing of the transmissions.

All being well, AfriStar will be launched this summer, with AsiaStar in December followed by CaribStar next June. They should have a lifespan of 15 years. For further details, check: `www.ftpb.u-net.com`

Contact: Annick Mallen French Technology Press Bureau, Tel: (0171) 235 5330.

Headless Robot Provides Insight into How Humans Walk



It doesn't have a brain or a heart, and its walk is a little like the scarecrow's, but a little headless, armless, trunkless two-legged robot, developed at Cornell University, can walk, wobble, hobble, limp, stride and stagger. But it can't stand still in any position without falling over.

The fact that this robot is stable in motion is giving mechanical engineers here new thoughts about how humans walk.

Michael Coleman, a lecturer in mechanical engineering at Cornell, said the little walker, by using gravity on a gentle slope performs repeatable, chattering, human-like stable steps without falling over.

"We believe this is the first two-legged, statically unstable 3-D passive-dynamic walker that can walk stably down a slope without any control system whatsoever," said Coleman.

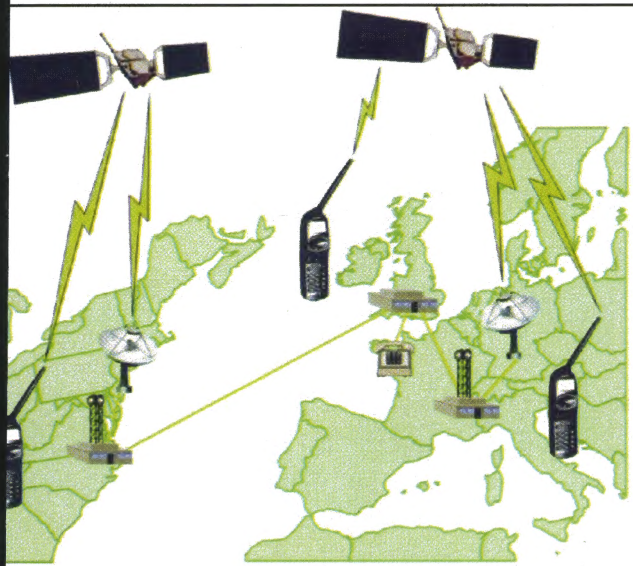
With help from Andy Ruina, director of the Human Power, Biomechanics and Robotics Laboratory at Cornell, Coleman stumbled on the walker's design

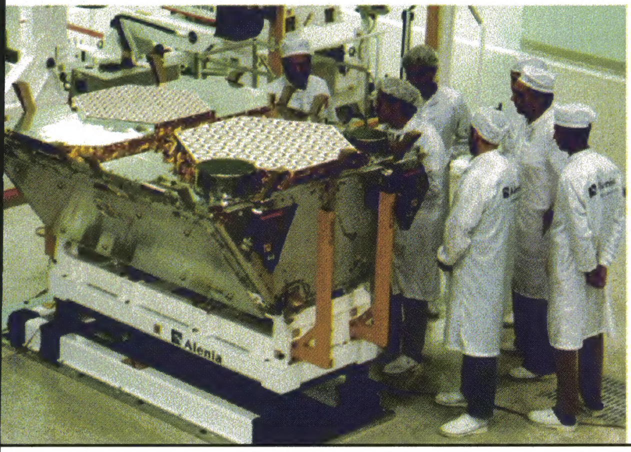
"In fact, it is one of the few devices of any kind that is dynamically stable near a staticall unstable configuration and doesn't have fast spinning parts," says Ruina.

For further information, check: `www.cornell.edu`.

Contact: Cornell University, Tel: +1 607 255 3651.

Ericsson Secures Deal for Satellite Phone





Ericsson has signed a technology license agreement with QUALCOMM, that allows Ericsson to design, develop, manufacture and sell handsets for use within the Globalstar world-wide mobile satellite digital telephone system.

Ericsson has also been subcontracted to design and manufacture dual-mode pre-production Globalstar handsets incorporating QUALCOMM's Code Division Multiple Access (CDMA) technology and Ericsson's Global System for Mobile Communications (GSM) terrestrial-based technology and expertise.

Globalstar routes a subscriber's wireless phone call up through one of 48 low-Earth-orbiting satellites, down through a gateway connected to the Public Switched Telephone Network (PSTN), and on to the calling party or the party called. If the call is destined for another portable Globalstar phone, the call continues through a second gateway, up to a satellite, and back down to the receiver.

For further information, check: **www.ericsson.com.**

Contact: Ericsson, Tel: (01444) 234354.

PC-TV Card Launched For Windows 98

Hauppauge has announced a TV-tuner system designed for use with Windows 98, to take advantage of one of the operating system's ew PC TV features. The circuit boards, which allow users to turn Cs into TVs, have been on the market for some time.

For further information, check: **www.hauppauge.com.**

Contact: Hauppauge, Tel: (0171) 378 1997.

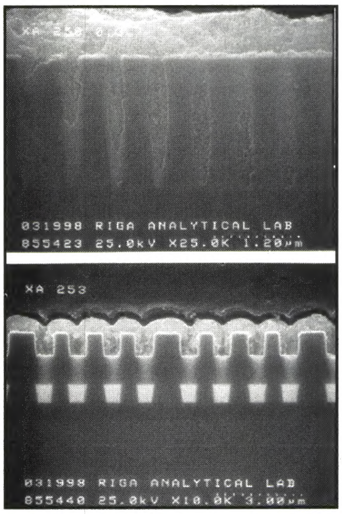
CuTek Breaks New Ground For Copper Deposition

CuTek Research has announced industry-leading performance results for copper film deposition. Recent applications work has yielded a process that provides complete hole fill without voids or seams for contacts with a 0.25um diameter and aspect ratio of 8:1.

This is the first demonstration of such aggressive hole fill performance by a copper electrochemical deposition (ECD) system for integrated circuit manufacturing applications.

For further information, check: **www.cutek.com.**

Contact: CuTek Research, Tel: +1 408 954 0888.


031998 RIGA ANALYTICAL LAB
055423 25.0kV X25.0K 1.20µm
XA 253
031998 RIGA ANALYTICAL LAB
055440 25.0kV X10.0K 3.00µm

Hayes Slashes Modem Prices

Hayes has slashed the prices of s internal and PC Card modems. The aggressive new ricing is expected to secure more sales of the company's V.90-ready ACCURA and OPTIMA products as the market moves over to 56kbps modems.

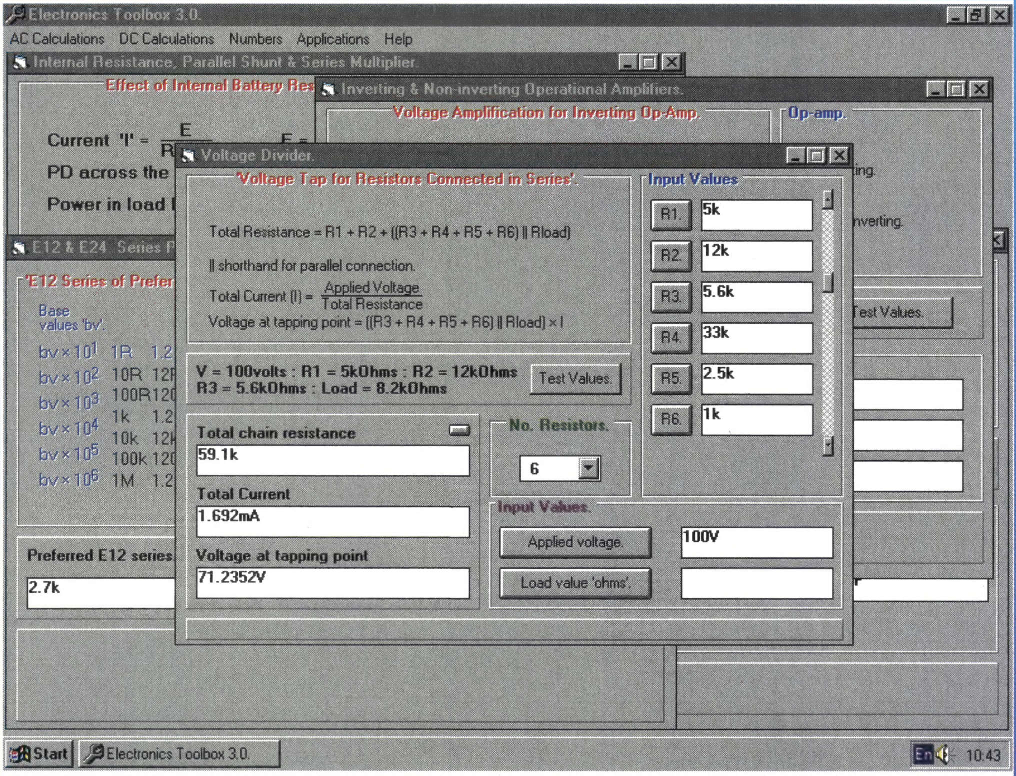
Prices for the Hayes ACCURA 56k external and internal modems have been cut by £20 to £129 and £119 respectively. The OPTIMA 56k Global PC Card is now £219, reduced from £239, while the OPTIMA Business Modem is now £60 cheaper at £199.

For further information, check: **www.hayes.com.**

Contact: Hayes, Tel: (01276) 704400.

Electronics Toolbox 3.0

A quick and easy way to make electronics calculations.



Voltage Tap for Resistors Connected in Series.

Total Resistance = R1 + R2 + ((R3 + R4 + R5 + R6) || Rload)

|| shorthand for parallel connection.

Total Current (I) = Applied Voltage / Total Resistance

Voltage at tapping point = ((R3 + R4 + R5 + R6) || Rload) × I

V = 100volts : R1 = 5kOhms : R2 = 12kOhms
R3 = 5.6kOhms : Load = 8.2kOhms

Input Values

R1. 5k
R2. 12k
R3. 5.6k
R4. 33k
R5. 2.5k
R6. 1k

Total chain resistance: 59.1k

Total Current: 1.692mA

Voltage at tapping point: 71.2352V

No. Resistors: 6

Applied voltage: 100V

Preferred E12 series: 2.7k

Electronics Toolbox 3.0
AC Calculations
DC Calculations
Numbers
Applications
Help
Internal Resistance, Parallel Shunt & Series Multiplier
Inverting & Non-inverting Operational Amplifiers
Voltage Divider
Effect of Internal Battery Res
Voltage Amplification for Inverting Op-Amp
Op-amp
E12 & E24 Series P
E12 Series of Prefer
Test Values.
Load value 'ohms'.
Start
10:43

Electronics Toolbox 3.0 provid the engineer, student or hobby with a range of commonly use electronics formula ar frequently used routines. Each which is easily selected from main menu, thereby enabli testing or finding compone values for a given situatic Example values are provided a start point, whereby changes any individual input v recalculate the result.

This software is ideally suited the user who wants a fast route an electronics solution witho having to repeatedly input th complete formula values to calculator.

Numerical Accuracy.

The default setting for accuracy is four decimal places. However, up to fifteen places may be selected when the output results produce very small voltages and currents.

Inputting of values.

Selecting a particular input i.e. voltage, current, frequency etc. is via a dialogue box whereby additional number formatting is performed. Values can be input using electronics symbols i.e. Ohms, kOhms, MOhms or uA, mA and Amps.

Output Results.

Resultant values are output again using electronics symbols i.e. Hz, kHz MHz or uV, mV, V etc. Formatted numbers are easy to read and readily identify changes. The use of scientific notation is avoided wherever possible to make the calculations meaningful.

One professional recently described the Electronics Toolbox as more useful than his scientific calculator which cost three times as much. This program is not intended to be an educational package as is the case of the Electronics Principles 5.0 title. Its appeal is for a quick and easy calculating solution, without the user having to try to remember or look up a particular formula and where individual component values can be changed to see the effect on the result.

£19.95*

Also from EPT

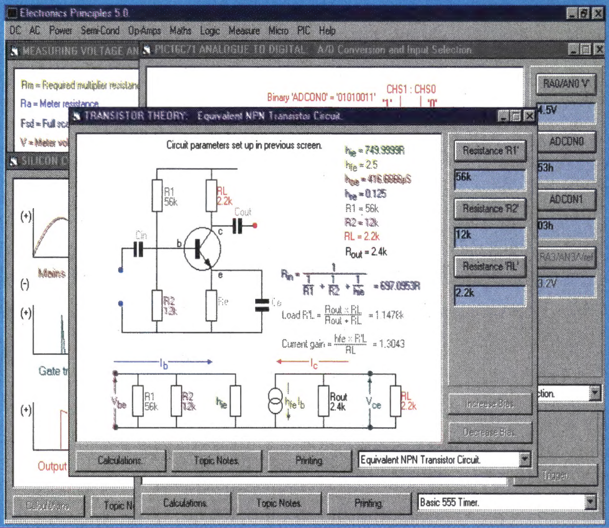
£99.95*

Electronics Principles 5.0

'A COMPLETE PC BASED ELECTRONICS COURSE'

If you are looking for an easy and enjoyable way of studying or improving your knowledge of electronics then this is the software for you.

Now includes the PIC16F84 & PIC16C71 hardware and instruction set.



Circuit parameters set up in previous screen.

h_{ie} = 749.9999R
h_{fe} = 2.5
h_{oe} = 416.6666uS
h_{re} = 0.125
R1 = 56k
R2 = 12k
RL = 2.2k
R_{out} = 2.4k

$R_{in} = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{h_{ie}}}$ = 697.0953R

Load R'L = $\frac{Rout \times RL}{Rout + RL}$ = 1.1478k

Current gain = $\frac{hfe \times R'L}{RL}$ = 1.3043

Resistance 'R1': 56k
Resistance 'R2': 12k
Resistance 'RL': 2.2k

Binary 'ADCON0' = '01010011'

EPT Educational Software. Pump House, Lockram Lane, Witham, Essex. UK. CM8 2BJ.
Tel/Fax: 01376 514008. sales@eptsoft.demon.co.uk http://www.eptsoft.demon.co.uk
*UK and EC countries add £2 per order for post & packing. VAT should be added to the total.
Outside Europe £3.50 for air mail postage by return.
Switch, Delta, Visa and Mastercard orders accepted - please give card number and expiry date. Cheques & Postal Orders should be made payable to EPT Educational software.

ELECTRONICS *Classified*

Wanted

Information about voice recognition, how it works, and circuit diagrams if possible.
M. Balahwal, Tel: (0161) 2951670.

Sony Betamax VCR must be stereo model may consider faulty model, parts needed have parts, tapes to trade. Betamax tape rewinder also needed.
Tel: (01604) 843536 (Northants)

PT100 temperature sensing element (platinum 100W @ 0oc, temp coeff. 0.38), contact, probe or skeleton type.
M. Perry 216 Marlpool Lane
Kidderminster Worcs DY11 5DL.

Placing an advertisement in this section of *Electronics and Beyond* is your chance to tell the readers of Britain's best magazine for electronics enthusiasts what you want to buy or sell, or tell them about your club's activities – Absolutely Free of Charge! We will publish as many advertisements as we have space for. We will print the first 30 words free, but thereafter the charge is 10p per word for each added advert per reader.

Placing an advertisement is easy! Simply write your advertisement clearly in capital letters, on a postcard or sealed-down envelope. Then send it, with any necessary payment, to: *Electronics Classified*, P.O. Box 777, Rayleigh, Essex SS6 8LU.

Advertisements will be published as soon as possible, space allowing. No responsibility is accepted for delayed publication or non-inclusion of advertisements.

Readers who have reasonable grounds to believe they have been misled as to the nature of an advertisement are advised to contact the Publisher and their local Trading Standards Office.

For Sale

Large box of electronic components including microprocessors, ICs, crystals, sockets, books etc. £60.
Tel: (01692) 536323 (Norwich area).

Electronics and weather recording devices detailed constructional guide to building a home made weather station. SAE for details to:
Mr D. Venuti, Mill House, Thurgarton, Norwich NR11 7HR.

Please write your classified advert using one word per box below.
Adverts of 30 words or under will be printed free of charge, but thereafter the charge is 10p per word. Please include any payment for extra words with your advert.

ELECTRONICS *Classified*

Name ____________________

Address ____________________

Daytime Telephone ____________________

Return your advert to: *Electronics Classified*, P.O. Box 777, Rayleigh, Essex, SS6 8LU.

APPOINTMENTS

Intec

THE CELLULAR SERVICE & LOGISTICS SPECIALIST

We are one of the largest Services Centres for mobile phones in the UK, situated just off Barnet High Street, with excellent staff facilities. The company continues to grow, therefore, we currently have the following vacancies to offer with competitive salaries.

EXPERIENCED TECHNICAL TRAINER REF: TT01

Ideal applicant will have extensive knowledge in the cellular industry. However, we will consider someone with vast electronic/repair experience with relevant skills and qualifications. You will have the ability to use your own initiative with excellent communication skills and a proven track record. Duties will include assessing and training technical staff to have a greater understanding of electronics repair techniques along with specific product knowledge.

TRAINEE TECHNICIANS & RADIO/ ELECTRONICS REPAIR TECHNICIANS REF: T03

Ideal candidates will be ex TV/video technicians, although consideration will of course be given to people with relevant experience who can demonstrate an aptitude for component level repairs. Individuals with theoretical knowledge without experience will also be considered. You will be computer literate, with a keen eye for detail, also you will have electronics qualifications minimum City & Guilds 224 (pt 1 & 2) or equivalent.

Karen J Chalk, Human Resources Manager
Intec Cellular Services Limited
50 Moxon Street, Barnet, Herts EN5 5TS

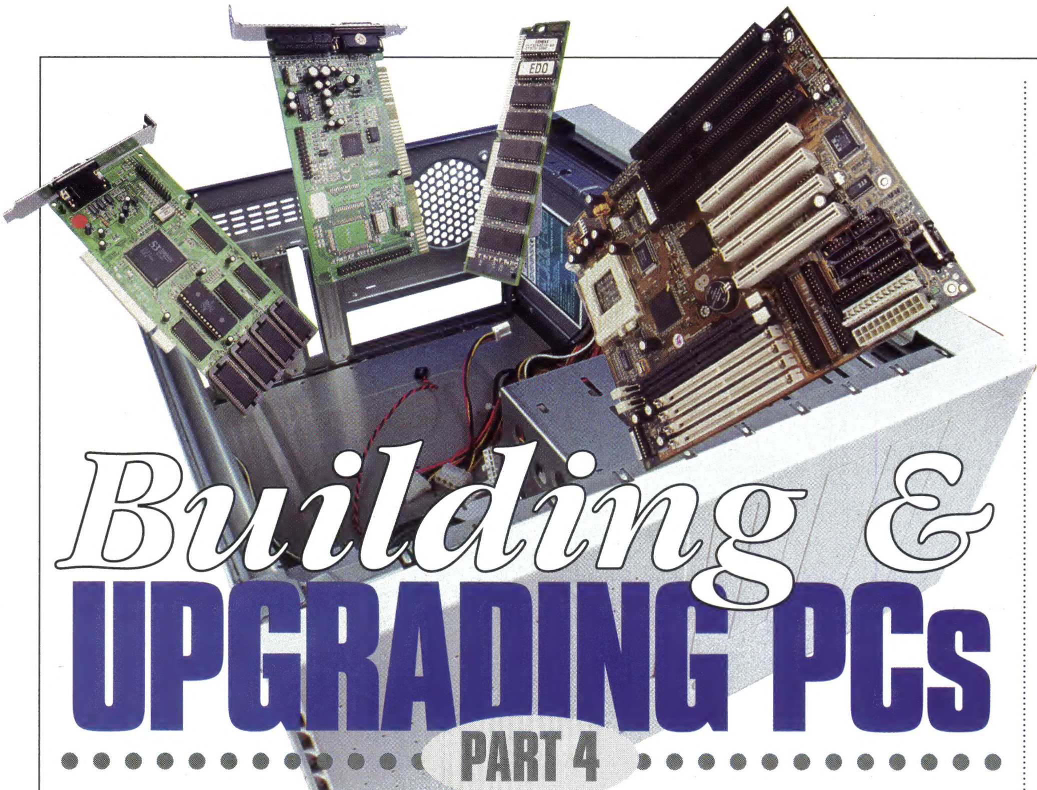
NATIONAL COLLEGE OF TECHNOLOGY

DISTANCE LEARNING COURSES in:

Analogue and Digital Electronic Circuits, Fibres & Opto-Electronics
Programmable Logic Controllers
Mechanics and Mechanisms
Mathematics

- Courses to suit ***beginners*** and those wishing to ***update*** their knowledge and practical skills
- Courses are delivered as self-contained kits
- No travelling or college attendance
- Learning is at your own pace
- Courses may have BTEC Certification and Tutoring

For information contact:
NCT Enterprises
Barnfield Technology Centre
Enterprise Way, Luton LU3 4BU
Telephone 01582 569757 • Fax 01582 492928



Building & UPGRADING PCs

PART 4

This month Mark Brighton takes you through the initial set-up procedure to get your PC configured and installs some fundamental software.

If you have been following this short series of articles, you should now know how to build a multimedia PC from scratch. You may have completed one for yourself already, in which case you should find this months article very useful if the thought of setting up the operating system software for the first time is a daunting one.

Our example PC is now at the stage where it may be switched on for the very first time. All being well, that diverse collection of parts you have chosen, purchased and lovingly assembled is about to spring into life as a version of that complex and almost infinitely variable animal we call an IBM compatible PC.

If you haven't already done so, have a las look inside the case. Mentally review the assembly process, give each lead and fixing a last glance. Do double check for any loos bits in the case just one more time before standing the case upright and connecting the peripheral parts. Stand the Video Monitor nearby and connect both the 15-way D connector and the power lead to th PC body. The 15-way connector fits the socket on the Graphics card (be careful to fit it the right way around as it will go in th wrong way if brute force is applied). Depending on the monitor type chosen, there may be a permanent mains lead connected to the rear of the monitor, or there may be a lead included that will plug into the monitor. Connect this to the femal Euroconnector on the rear of the power supply block on the PC case.

Plug the keyboard into the 5-way DIN connector on the motherboard and plug the tiny PS/2 DIN Mouse connector into th round socket on the adaptor plate on the back of the PC. Please be careful to align th plug correctly as it is a little fragile.

Lastly, connect the mains lead to the remaining Euroconnector on the power supply and plug it into a convenient mains outlet. Leave the case side off for now as you will most likely need to make some

Our completed multimedia PC setup with WIndows 95.

Windows 95 OEM version

The full (non-upgrade) version of Windows 95 is only supplied with hardware for a new PC. Maplin are able to supply this package with the component parts for your new PC, if ordered at the same time as hardware.

There is no doubt that the process for setting up your PC with Windows 95 is made far easier using the full service release of Windows 95. This version of Windows was designed to be used by OEM's (Original Equipment Manufacturers) when they installed operating systems on PC's for sale. It requires only a basic DOS (command.com) program to be written to the hard disk, as well as a set of CDROM drivers to allow the Windows 95 CD to be read from.

If you purchased a copy of Windows 95 OEM version from Maplin, then it will be supplied with a bootable floppy containing the Windows 95 version of the main DOS file 'command.com', amongst other files. Having run EZ Drive and been prompted to enter a system disk, you should insert this disk now and press 'Y' to continue. Once the program has finished, restart the computer using 'Cntrl-Alt-Del', with the Windows 95 start up disk still in the floppy drive.

When the system restarts, it will attempt to start loading Windows 95, assuming the CDROM drive to be drive 'D:'. if, as in our example, it isn't drive 'D:' because the existence of a logical drive partition has pushed it higher (EZ Drive has split the very large hard drive into two more manageable partitions, 'C:' and 'D:') the batch program on the floppy disk will stop with error messages. This isn't a problem. The software on the floppy drive should have identified your CDROM drive when your PC restarted, and allocated letter 'E:' to it (or the letter after your highest partition letter). Simply type 'E:', then type 'setup' to start the Windows 95 set up procedure.

Simply follow the on screen prompts, leaving the Windows destination directory and set up option at their default settings. Enter the identification number printed on the certificate of authenticity on the front of your Windows manual and then fill out your own details on the following screen, using the mouse to move the cursor from the name text entry box to the company box (click in the box), not the enter key.

Final setting up

Once you have finished setting up and restarting Windows 95, you will need to install the special driver software that was supplied with your graphics and sound cards, in order to get the best performance from them. Locate the CD supplied with the graphics card and insert it into the CDROM drive.

Right click your mouse, with the mouse arrow positioned anywhere on the background of your main screen, or Windows 'Desktop'. You will see a small pop up menu appear. Select 'Properties' and the window for your graphics settings will appear. Select the 'Settings' tab on the upper right of the window and then click on 'Advanced properties' at the bottom right (note that older versions of windows may have a button marked 'Change Display Type' instead).

Remember to keep your driver and Windows disks in a safe place.

The next window that appears has tabs at the top, the first being 'Adapter' (depending on your version of Windows 95). From this screen, click on 'Change' (there may be a delay while Windows builds a driver information database) and click 'Have Disk' on the following screen. When prompted for the location of the manufacturers files, choose 'Browse' and then select the CDROM drive ('E:' in our example) from the bottom right of the next window.

Double click the folder titled 'Virge-dx' (scroll down to see it using the scroll bar on the right). When the folder opens, select the sub-folder titled 'Win 95' and then click the 'OK' button. Click 'OK' again on the screen underneath, then once more on the screen showing the display adaptor type selected. Windows will then install the new driver software and rebuild it's driver information database. When Windows prompts you to restart your computer, choose not to at this time.

Sound card

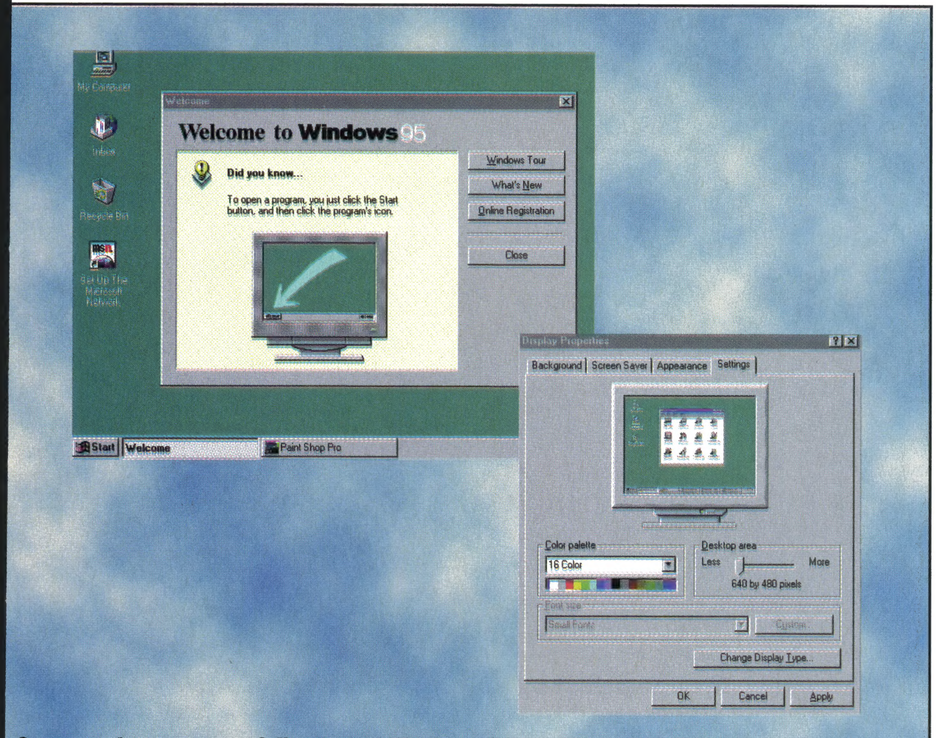
If your PC has not so far prompted you to install the driver software for your new sound card, they may be a software or hardware conflict of some sort on your PC. Click 'Start/Settings/Control Panel' and double click 'System'. Choose 'Device Manager' and you will see a summary list of the parts of your system. Double click on 'Other Devices' and on 'Sound, Video and Game Controllers' and each of these will expand to show each device installed. If any of these have a yellow exclamation mark 'sticker' on top of their icon, it is a sign that all is not well! If that does happen to you, click on each of the devices in the 'Sound, Video and Game Controller' list in turn and click 'Remove' until they have all gone. Now select the entries in 'Other Devices' and remove any that refer to the sound card, leaving just those pertaining to PCI (two entries). Restart windows and the sound card should then be detected as new and you will be prompted to install the driver software from the CD that came with your sound card, as described in the Windows set up above.

Once the driver is installed and you have restarted your PC yet again, (note that your PC may autodetect your monitor and configure further driver software at this stage, depending on the type used), all that remains for you to do is to set up the wavetable option of your sound card as the preferred playback option. The wavetable sound synthesis on this card is driven entirely by software as opposed to the more conventional hardware wavetable derived synthesis. You will need to open Control Panel once more, double clicking on the 'Multimedia' icon to bring up the screen containing playback options. Select the 'MIDI' tab at the top of the screen and you will see that there are three MIDI playback options. The default option is for playback via the internal FM synthesiser, which works, but doesn't sound very realistic. The second option, MPU40, redirects all midi output to the 15-way D-connector at the rear of the sound card. This may be used to drive an external music synthesiser via a special cable such as the VL80B supplied by Maplin.

Select the third option by clicking on it. This will activate the software wavetable synthesis mode of the sound card and driver software, giving far more realistic results for any musical output from your PC.

That completes the setting up of your new PC! If you have followed every step in this series, you should have a fully functioning multimedia PC! All you have to do is to install the software of your choice and enjoy it.

Next months article will round off the series with a look at fault finding should things not have gone quite to plan, as well as how to add extra peripherals such as an extra hard drive and a 3DFX graphics accelerator card.



To open a program, you just click the Start button, and then click the program's icon.

Once you have successfully started Windows 95, install your driver software.

daptor or sound card. Just click on continue'. A search of your PC will ensue, ith much hard drive activity and some elay. Don't be tempted to switch of and eboot, even if this takes several minutes. If Vindows detects your sound card at this oint, you may insert the CD provided with he sound card in the CDROM drive now. Vindows will attempt to locate the driver oftware for the new sound card. If it loesn't automatically locate the drivers on he CD, use the browse button to select the :\Win95 directory on the CD and click 'OK' o continue. When Windows has finished etting up your sound card, remove the CD rom the drive and replace the Windows 95 CDROM.

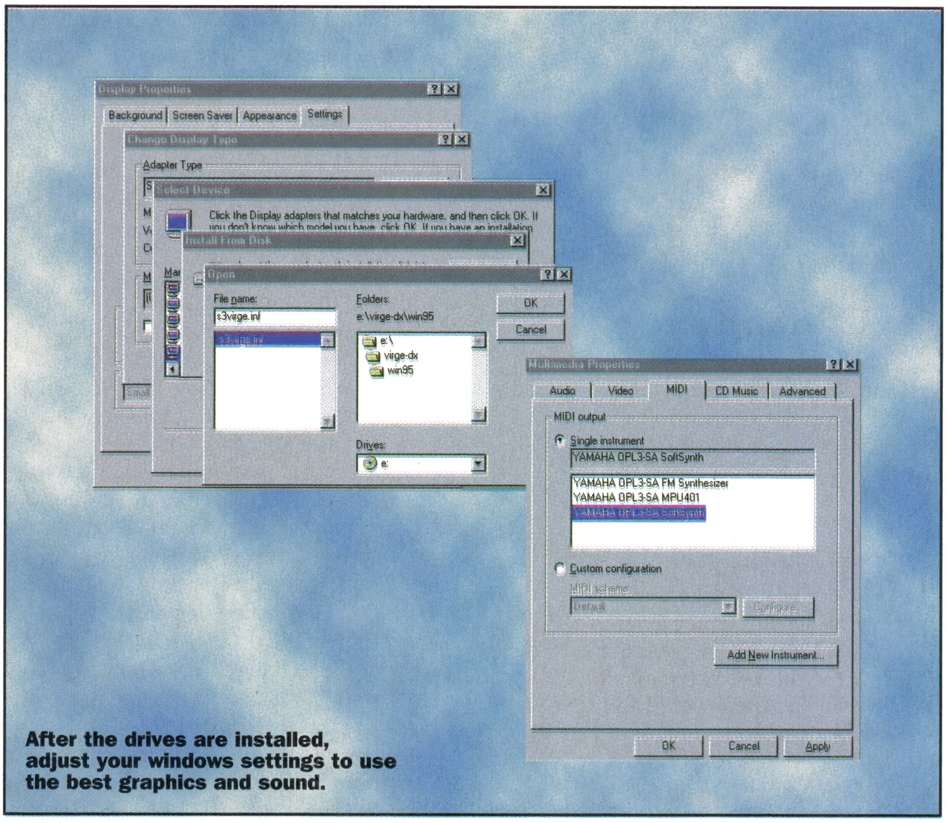
The next option offered is to set up etworking or modem software. If you ntend to use the PC with a fax/modem ard, to connect to the Internet or just to onnect to private bulletin board systems, r other PC's or just to send and receive axes, then you might wish to select one or more of these options at this point. Once ny options required have been selected by hecking (ticking) the relevant boxes, click Next' to continue. Windows 95 will then give you the choice of automatically nstalling common options, or leaving you o manually select system components from (long) list. I would suggest that, unless ou are already experienced with Windows 5 and are aware of any non default options ou feel you need from day one, you just allow an auto set up. Whether you allow Vindows to create a start up disk at this point is entirely up to you. It does (probably!) allow access to your system for ome rescue work if things go badly wrong t any stage, but you will also need to ensure that any CDROM drivers present on our hard drive are also present on the loppy and that commands referring to the drivers are redirected to use the floppy ased versions, so this isn't as simple as it might appear. There are various other useful rescue programs you may wish to include on a boot floppy to allow you to access and edit files on your hard drive if the worst happens and Win 95 won't start. Top of my list are the DOS 'Edit.com' program to allow 'Autoexec.bat, Config.sys' or Windows '*.ini' files to be edited and resaved, and the all important DOS 'Keyb.com' program to allow the command 'Keyb uk' in 'autoexec.bat'. If you forget this one, or any page information that may be required to go with it, you will find that you can't type the character 'tilde' (~). Not important, you might think, but you would be wrong! DOS cannot handle the long file and folder names used by Windows 95 and will truncate them to the normal eight character dot three extender format, with the last characters being, yes, a tilde and an identification number! So, if you haven't realised the import of all this, without the ability to type a tilde, you won't be able to access any of the directories with long folder names from DOS.

If most of the above was gobbledegook to you, don't worry. Create a start up disk, or not, as the fancy takes you. The next stage in the process is where the bulk of your Windows 95 files are copied from the CDROM to your hard drive and will take some considerable time. Oddly, the machine I used asked me to insert the Windows 95 CD in the CDROM drive, although it was already there! Clicking 'OK' seemed to satisfy it and the set up process continued.

Once your PC has finished copying files from the Windows 95 CD, it will prompt you to remove any floppy disks from the machine and click 'Finish' to restart your machine using the new operating system.

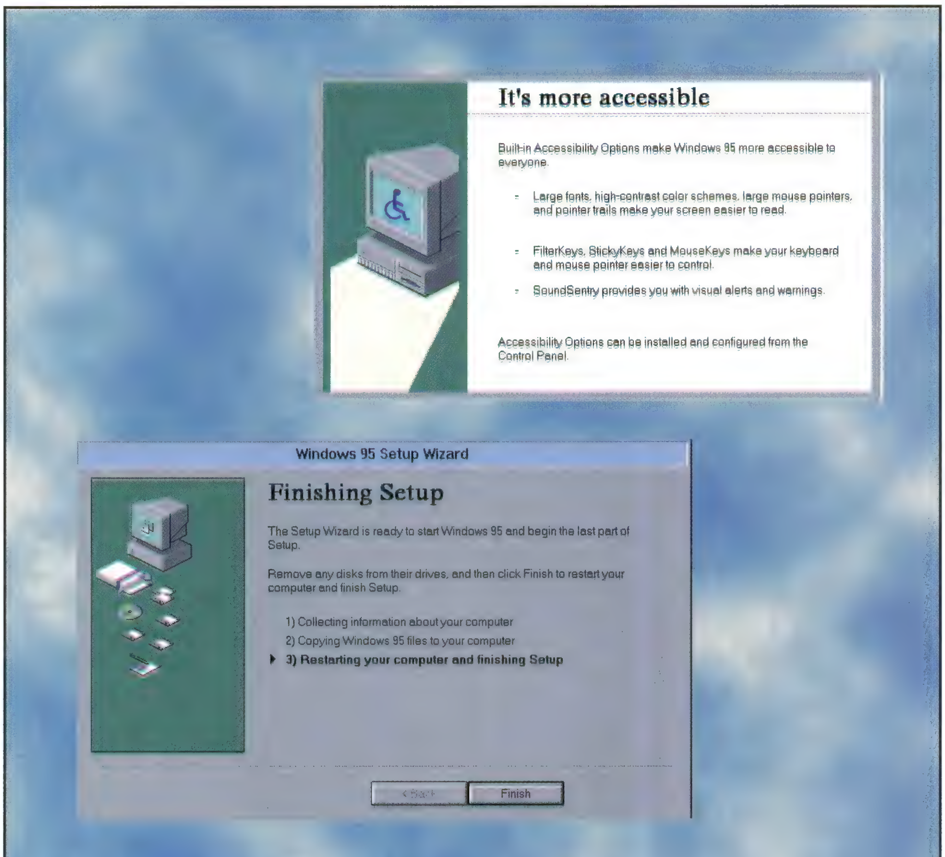
The computer will reboot, displaying a special first time screen and setting up plug and play devices, as well as the standard Windows screens and menu options, before stopping to prompt for your time zone. Reset this if necessary and click on 'Close'. This will take you onto a printer set up wizard. If you don't have a printer, or wish to set it up later, just click on 'cancel', then on 'OK' on the next window to restart Windows 95.

Having restarted Windows 95, you will see a screen inviting you to take a tour or tutorial. Behind that is the standard Windows 95 desktop. You have successfully installed your operating system. Now skip the next section, for users having the full OEM version of Windows 95, and continue with 'Final steps'.



Click the Display adapters that matches your hardware, and then click OK. If you don't know which model you have, click OK. If you have an installation

After the drives are installed, adjust your windows settings to use the best graphics and sound.



It's more accessible

Built-in Accessibility Options make Windows 95 more accessible to everyone.

- Large fonts, high-contrast color schemes, large mouse pointers, and pointer trails make your screen easier to read.
- FilterKeys, StickyKeys and MouseKeys make your keyboard and mouse pointer easier to control.
- SoundSentry provides you with visual alerts and warnings.

Accessibility Options can be installed and configured from the Control Panel.

Windows 95 Setup Wizard

Finishing Setup

The Setup Wizard is ready to start Windows 95 and begin the last part of Setup.

Remove any disks from their drives, and then click Finish to restart your computer and finish Setup.

1) Collecting information about your computer
2) Copying Windows 95 files to your computer
▶ **3) Restarting your computer and finishing Setup**

The setup process will take some time to copy all the files.

Now you may enter the 'SeePU' screen and just check that the motherboard has correctly identified the processor or CPU that you have fitted. It will identify almost any variant of all the common processors, but if it has chosen incorrectly, you may (IF VERY SURE) override the automatic settings from this screen.

Finally select the 'Save & Exit Setup' option, press 'Y' when prompted on the way out and the machine will continue to boot.

Hard drive set up

All being well, you machine should now proceed to load the Western Digital EZ Drive program from the floppy disk. You will have been provided with a large chart showing the sequence of screens you should encounter whilst using this program. I will have to admit that I didn't find it very useful as reality rapidly diverged from the plan, as often happens in real life!

The first thing that the EZ Drive program will do is to examine your motherboard BIOS to see if your system is capable of handling large hard drives. Depending on the age of the motherboard design, some motherboards are unable to directly access the full drive size we have recommended, in which case EZ Drive will install a small program that bolts on to your BIOS program and adds the ability to address large hard drives.

Once you move through the first two introductory screens, you will reach the main menu. Choose 'Fully Automatic Install'. When this process starts, the program will first check your hard drive for the existence of an operating system. As The hard drive is a new one, none is found and the program will prompt for a system disc to be inserted in your floppy drive. This is where the choices start, depending what you have in the way of system disks. We will start by assuming that you have had a PC before and have a set of DOS disks, a copy of Windows 3.1 or 3.11 on floppy and an upgrade copy of Windows 95 on CDROM. This is by far the longest set up path, but sometimes the cheapest if the software is already available. Those of you with a full OEM copy of Windows 95, and the necessary start up (boot) floppy disk with system files on may skip the following section and go to 'Windows 95 OEM version'

DOS, Windows 3.1 and Windows 95 upgrade

Remove the EZ Drive disk, insert disk one (Set up) of your DOS set into the floppy drive, and press 'Y' to continue. The program will inform you that, because of DOS (space addressing) limitations, at least two partitions must be created on your 3.0GB hard drive. Accept the partition sizes suggested and continue to format and partition the hard drive. When that process has finished, remove the DOS floppy disk and press 'Esc' to restart the system as suggested.

Your computer should then restart, booting your chosen DOS version from the hard drive. It may prompt for time and date on the way in. If so just return through these prompts to leave the data unchanged. Having proved that the hard drive will boot correctly, insert the DOS disk one in the floppy drive and press the 'Ctrl - Alt - Del' keys simultaneously to restart your system again and start the full DOS installation process. Although we won't really use this version of DOS, the set up sequence creates files that are used by the CDROM drive software set up later on. When the DOS set up program runs, it will detect the DOS system files written to the hard drive by EZ Drive and recommend you exit set up. Override this recommendation by stepping down to the next option and continue with the set up, following the on screen prompts

Set your country/keyboard types to 'United Kingdom' on the next screen, using the cursor keys and return to make your selections. The program will then create the 'C:\DOS' directory and install the suite of DOS programs on your hard drive, prompting for disks two and three as it goes

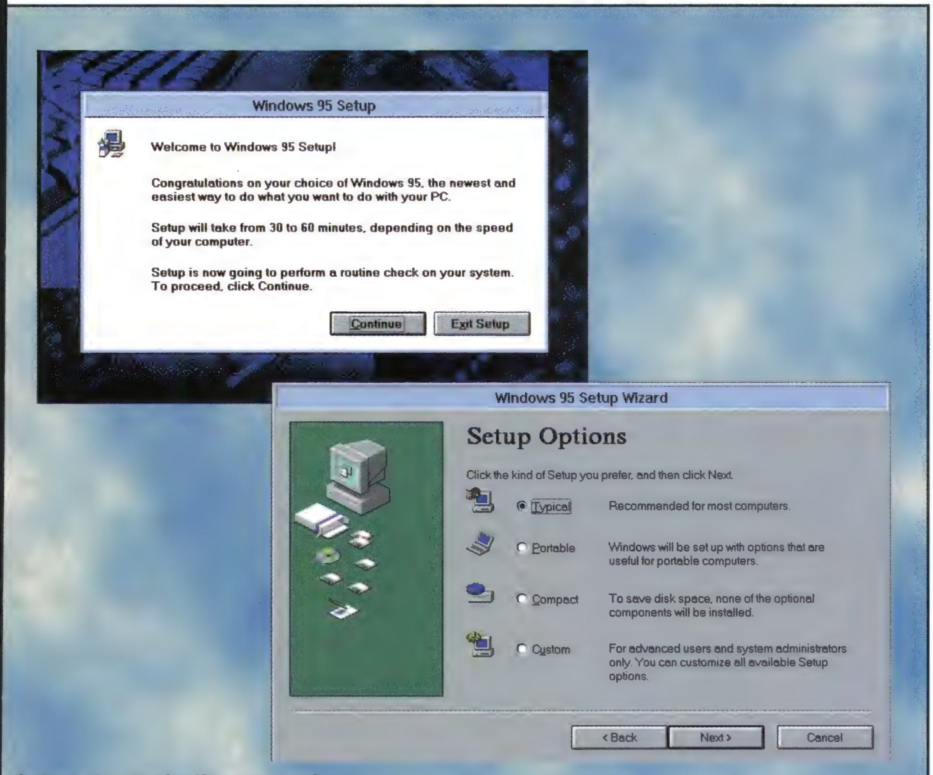
Once the DOS system is set up, remove the last DOS disk from the drive and restart the PC as prompted. The PC will restart, finishing with the DOS 'C:\>' prompt. Inser the driver disk supplied with the CDROM drive, change to the floppy drive by typing 'A:' and enter, then type 'Install' and enter t set up your CDROM drive software. Follow the default prompts through the CDROM set up screens by pressing enter for each highlighted choice and the software will install. Remove the disk and use 'Cntrl - Alt Del' to reboot once again.

You should notice that the series of text screens at start up is a little longer this time and ends with a set of results from two programs to do with the CDROM drive. The ATAPI CD-ROM device driver should report successful installation of one CDROM drive, and the Microsoft MSCDEX program should report the drive letter allocated to the new CD device, eg, 'Drive E: = Driver CD00 unit 0'.

Press the drive tray control button on the right hand side of the CDROM drive and insert your Windows 95 upgrade CD. Type enter after each of the following entries. Type 'E:' to change to the CDROM drive, then type 'setup'. The Windows 95 set up program will start and run a DOS program called 'Scandisk' that checks your hard drive for any problems before going on to start the Windows 95 installation process.

The upgrade version of Windows 95 requires that you already have a previous version of Windows, but does not require you to actually install it. Continue through the screen prompts, accepting the Microsoft license agreement until you reach the point where the hard drive search for a qualifying upgrade product fails. Insert disk one of your older Windows set into the floppy and continue to the next screen. Ensure that the drive searched is set to 'A:' by changing it at the bottom of the next screen. Like most Windows select boxes, clicking the downward pointing arrowhead to the right o the text for the currently selected device will show all possible options in a pop up box. Just left click on the A drive text to select this drive, then continue with the search. After looking at the floppy drive, the set up program will continue, prompting you with various options that may be left as they are for now. You may always change Windows 95 configuration at a later date. Enter your name and Company name (if required) when prompted, and then enter the 10-digit identification key number from the sticker on the rear of your upgrade CD case or sleeve.

The set up 'Wizard' program will then ask you if you wish it to set up a Network



Welcome to Windows 95 Setup!

Congratulations on your choice of Windows 95, the newest and easiest way to do what you want to do with your PC.

Setup will take from 30 to 60 minutes, depending on the speed of your computer.

Setup is now going to perform a routine check on your system. To proceed, click Continue.

Click the kind of Setup you prefer, and then click Next.

- ● Typical Recommended for most computers.
- ○ Portable Windows will be set up with options that are useful for portable computers.
- ○ Compact To save disk space, none of the optional components will be installed.
- ○ Custom For advanced users and system administrators only. You can customize all available Setup options.

Select the 'typical' setup option.

djustments to LED connections and so on fter starting your PC for the first time. Note hat the only mains wiring normally present uns from the power supply case to the nain power switch on the front panel, with nsulating boots normally fitted over the witch terminals. Do be careful though, not o delve unnecessarily inside the case. I vould also strongly suggest you remove any ewellery you may be wearing before eaching inside the case, especially with the ower on. The low voltage supplies don't oresent a shock hazard, but 20A power supplies short circuiting through rings, vatch straps, bracelets or necklaces could cause nasty burns to both you and to your new PC circuitry.

Those of you using the recommended Western Digital hard drive will have been supplied with a floppy disk with a program called 'EZ DRIVE'. Insert this disk into the loppy drive now.

Initial power up

The time has almost come to cross your ingers, hold your breath and firmly press he power switch on the front of the PC case. Just read the next two paragraphs before hitting the switch. All being well, you should hear the fan start up inside the PC, he PC speaker will 'bleep' once, the monitor screen should flash or flicker and hen display the motherboard start up screen. If this doesn't happen within five to en seconds, switch off the PC and start to worry! We will cover some fault finding later, but let's assume for the moment that this works. At the bottom of the first screen displayed, you will see a message that reads Press DEL to enter set up'. This will only be shown during the system memory test, which only takes a few seconds. Press the DEL' key at the bottom right of the keyboard at this time and you will bring up a brightly coloured 'CMOS Setup Utility' screen, blue in our example. This contains a number of menu options designed to allow you full control of many complex technical parameters of your PC. Please don't be tempted to adjust any settings unless you have had experience of BIOS settings in the past and are sure that you know what you are doing.

At this stage, we are just going to set a few basic system parameters. We will make sure that the PC knows what disk drives are fitted (with the exception of the CDROM drive), what the time and date is and what order to look at its drives in when powering up.

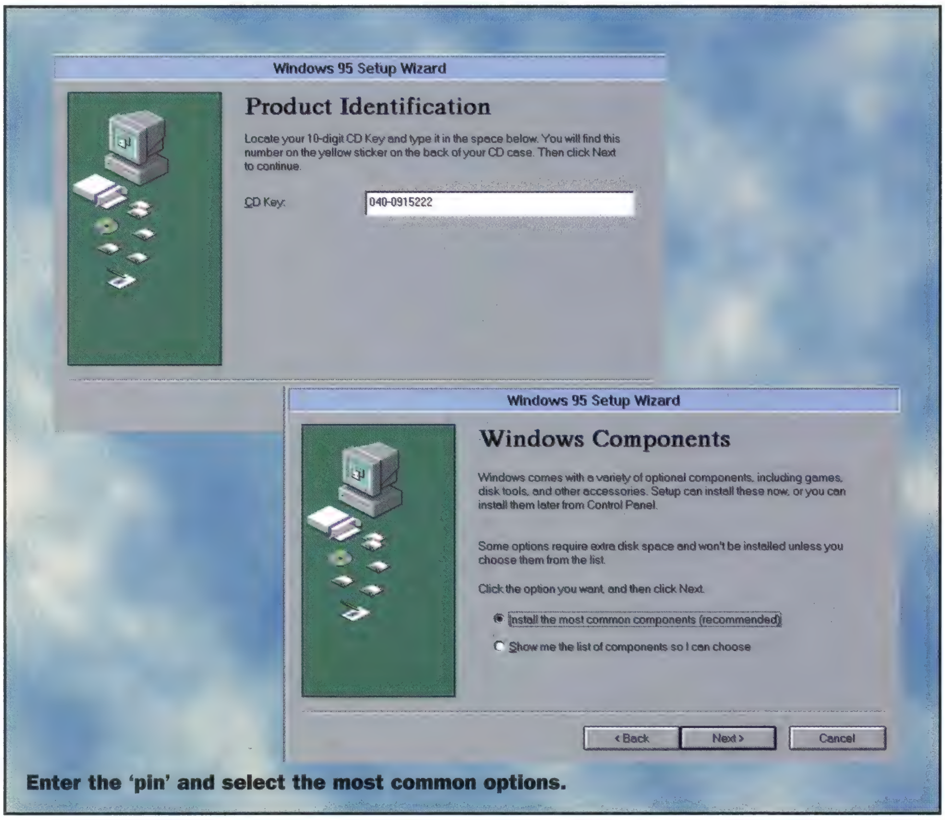
The motherboard in our example uses an Award BIOS/CMOS setup program and is driven entirely from the keyboard. Use the cursor (arrow) keys to position the highlighting on the option you wish to choose and hit Enter to select it.

Select 'Standard CMOS setup' and hit Enter. A new screen will be displayed, showing the current date, time and basic machine set up including drive types. Use the cursor keys to select the item to be changed and use the 'Page Up' and 'Page Down' keys just above the cursor keys to change the item until correct. When changing the date and time you will soon notice that 'Page Down' changes the number upwards and 'Page Up' changes it to a lower number. Welcome to the logical world of the PC!

You may find that the date and time have already been set correctly as many of the motherboards will have been set up and tested in the UK already. You will probably need to select drive A as being 1.44M, 3.5". We will leave all four possible IDE drive parameters set to 'Auto' and press 'Escape' at the top left (Esc) of the keyboard to return to the main menu.

Move the highlight/cursor to the 'IDE HDD Auto Drive Selection' option and press Enter. The screen will then show a dismayingly complicated set of numeric parameters for each IDE hard drive it finds attached to it, offering you three different options for each one. Don't worry about this, it's just showing off and you need only hit the 'y' key and press Enter for each set of figures it offers you to give the illusion that you are in complete control of the whole process.

Returning to the main menu again, select 'BIOS Features Setup' and set the 'Boot Sequence' to 'A,C,SCSI'. This sets the order each drive will be looked at for an operating system and initial program to run at each reset and power up.



Locate your 10-digit CD Key and type it in the space below. You will find this number on the yellow sticker on the back of your CD case. Then click Next to continue.

CD Key: 040-0915222

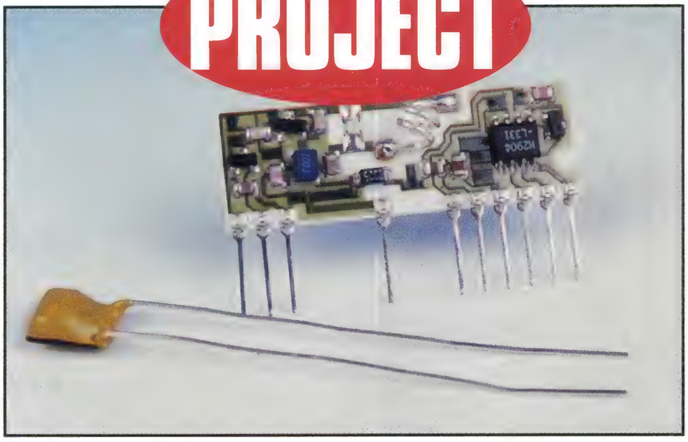
Windows comes with a variety of optional components, including games, disk tools, and other accessories. Setup can install these now, or you can install them later from Control Panel.

Some options require extra disk space and won't be installed unless you choose them from the list.

Click the option you want, and then click Next.

- ● Install the most common components (recommended)
- ○ Show me the list of components so I can choose

Enter the 'pin' and select the most common options.



418MHz LOW POWER TX & RX MODULES

PART 1

Gavin Cheeseman looks at applications for this pair of low-cost RF modules.

Maplin have introduced a low cost, low power 418MHz AM transmitter receiver pair (stock code NW43W). The system, which is exempt from Wireless Telegraphy licensing requirements, conforms to DTI specification MPT 1340 and makes use of the deregulated 418MHz band.

Transmitter

The transmitter module is supplied as a two pin package as shown in Figure 1. The module is simple to use, requiring only the addition of a capacitor, resistor, antenna and suitable power supply to complete the basic circuit (see Figure 2). The drive voltage requirement for the transmitter can be chosen by selecting the appropriate value for dropper resistor R1. A table of values is given in the leaflet supplied with the product. Module current consumption is typically <4.6mA allowing it to be driven directly from a logic IC if required. Maximum data rates up to 1200 baud can be accommodated.

When the transmitter is used with the specified antenna and receiver, line of sight ranges up to 100m can be obtained. In practice the maximum range is very much dependant on location and reduced distances can be expected in places where the transmission path is obstructed by walls or other solid structures. Depending on your application, this is not always a disadvantage.

Receiver

The receiver takes the form of a hybrid module as shown in Figure 3. All that is required to produce a fully functioning receiver is connection to a suitable antenna and power supply. The current consumption of the receiver is typically 2.5mA making it ideal for use in conjunction with low power circuits. The receiver output is able to drive standard 5V logic devices. The output switches to a logic high state when a signal is detected.

For satisfactory operation, it is recommended that separate +V and 0V (ground) rails are used for the RF and AF sections of the receiver. The receiver provides separate pins for these connections.

In terms of an antenna, effective performance can be achieved using the short whip or loop designs specified for the transmitter in the leaflet supplied with the product.

Applications

The modules can be used in a wide range of different applications and as long as you stick to the license exemption requirements, you are relatively free to decide how and where you want to use the system.

Whatever use you put the transmitter and receiver modules to, one point that must be remembered is that you are restricted to a limited data rate. This is necessary to ensure that under all conditions the transmission falls within the allocated frequency band. As a result, some ingenuity is required if the modules are to be exploited to their full potential. However, don't let this put you off. There are a whole host of control and slow speed data applications where the data rate restriction poses little or no problem

A few ideas to get you thinking

Using the modules in their most basic form, it is possible to make a simple remote control system. As mentioned earlier, when the receiver detects a signal from the transmitter, a logic high is produced at the receiver output. In its simplest form the output from the receiver could be used to drive a transistor and switch a relay. The relay could then, for example, be used to switch on an electric light bulb. This simple type of system is all very well but it suffers from some serious drawbacks. Firstly, if the receiver detects random noise at the operating frequency of the radio link, it will produce short duration pulses at the data output. Unless steps are taken to minimise the problem, then the relay will switch spuriously each time a pulse is received. This may make an interesting light show but is of little practical use!

Another problem with a system of this type is that it will respond to other intentional transmissions at or near the operating frequency. There is nothing to distinguish the control signal that you are transmitting, from, for example, the signal from your neighbour's wireless alarm system or wireless doorbell if these are transmitting at the same frequency.

Because of its inherent shortfalls, the system described above would probably be of little use in any serious application. There are several ways to overcome these problems and the chosen method depends very much on the application and how important it is that your circuit does not suffer from unwanted triggering. The block diagram of a simple system providing some degree of immunity is shown in Figure 4.

In the example, the transmitter is being used to control remote equipment such as lighting. The arrangement shown makes use of the discriminating properties of the Phase Locked Loop or PLL. At the transmitter end, a switch is used to control a 500Hz square wave oscillator. The output from the oscillator is used to drive the transmitter. (A typical method of modulating the transmitter is shown in Figure 5. The module can also be driven directly from logic IC's where appropriate.) While the switch is in the off position the circuit remains inactive. When switched on the transmitter emits a signal in the form of a 418MHz carrier wave, fully amplitude modulated by the 500Hz square wave. At the receiver end, the modulated transmission is detected and demodulated. A 500Hz square wave corresponding to the square wave modulating the transmitter is produced at the receiver output. The signal from the data output of the receiver is fed to a PLL detector (tone decoder). The PLL circuit effectively compares the frequency of the incoming signal to that of its own internal oscillator. The PLL can

In order to comply with current DTI regulations, it is essential to adhere to the License Exemption requirements detailed in the leaflet supplied with the product. The requirements include limitations regarding maximum antenna dimensions and mandatory labelling. There are also specific legal requirements regarding the use of the 418MHz band and if unsure, readers are advised to seek further advice with regard to the legality of a particular application.

MPT 1340
W.T. LICENCE
EXEMPT

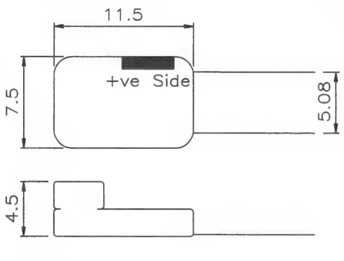


Figure 1.

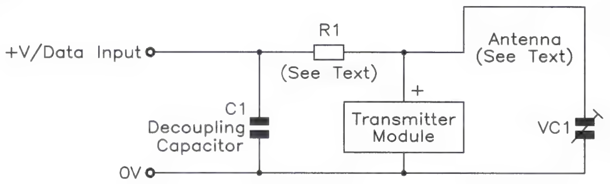


Figure 2.

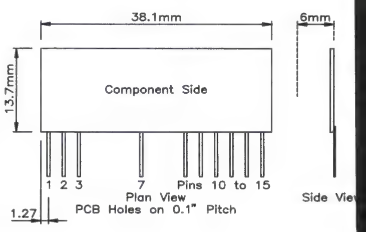


Figure 3.

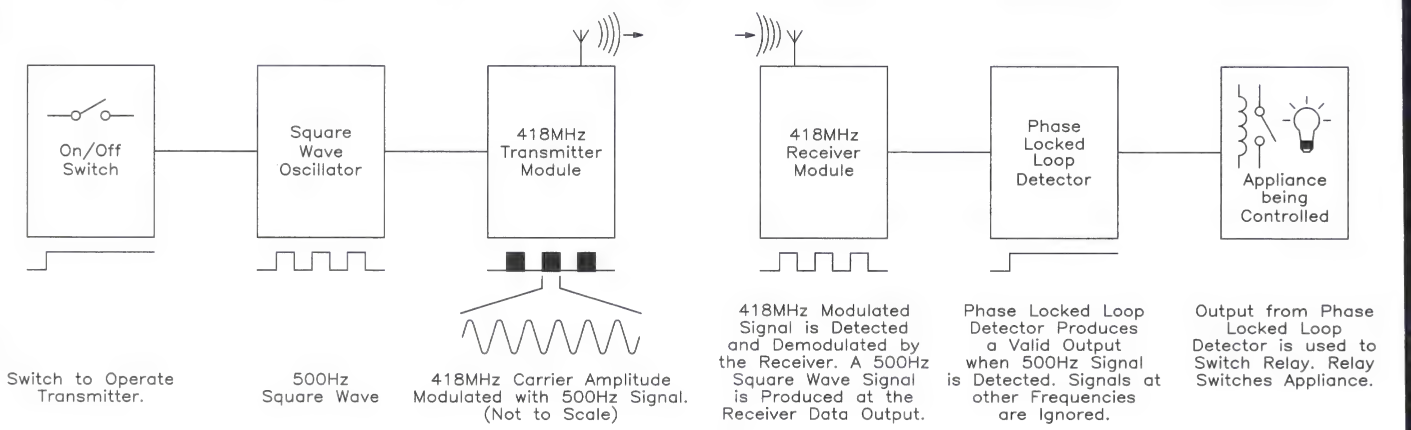


Figure 4.

differentiate between signals of different frequencies and will only respond to signals at or close to the frequency at which it is designed to operate. In our example, the internal oscillator of the PLL would be set such that the device responds only to frequencies in the region of 500Hz (the frequency of the oscillator modulating the transmitter). When a signal of the correct frequency is detected the PLL produces a valid output. This may be either a logic high or a logic low depending on the arrangement of the PLL circuit. In our example, a valid output from the PLL is used to switch a relay which in turn switches the lighting or other appliance being controlled.

The advantage of using the PLL system is that it is relatively unaffected by noise and also provides some degree of immunity to other users operating at the same radio frequency. The system is not totally impervious to interference, as it will, of course, pick up other transmitters being modulated at the same frequency as your own. The way to get round this is to use a digital encoder in place of the square wave oscillator, and to replace the PLL circuit with a suitable decoder. This may seem complex to the uninitiated but digital encoder and decoder IC's are readily available off the shelf, and are relatively inexpensive. These devices are generally very simple to use and can provide many thousands of code combinations. Examples are the M145026B-1 encoder (Maplin stock code UJ49D) and M145027/8B-1 decoders (Maplin stock codes UJ50E and UJ51F). Typical transmitter and receiver circuits using these IC's are shown in Figures 6 - 8. These are provided for guidance only and in practice may require some modification to obtain acceptable performance.

Figure 6 shows how the 418MHz transmitter module may be interfaced to the M145026B-1 encoder IC. In this example, a serial code is produced on IC1 pin 15 when a logic low is applied to IC1 pin 14. The serial code is determined by the state of the nine address lines. The output from IC1 pin 15 drives transistor TR1 which, in turn, drives the transmitter module. Capacitor C1 provides de-coupling for IC1 whilst R1 and C2 are timing components.

Figure 7 shows a decoder circuit based around the M145027B-1 IC. As mentioned, the encoder IC transmits 9-data bits. The decoder circuit shown treats only the first 5-bits of incoming data as address data. If the first 5-data bits correspond with the code set on the IC's address lines then the data contained in the remaining 4-bits is latched onto the IC data outputs. This allows additional control data etc. to be transmitted alongside the access code. The control data can be used in a variety of different ways, eg. the data outputs could be used directly to switch four separate appliances on or off or, alternatively, could be decoded further to provide a whole range of different control options. In addition to the 4-data bits, the Valid Transmission output switches to a logic high state, while the correct code train is being received. Capacitors C1, C2 and C5 provide high frequency de-coupling whereas C3 operates at lower frequencies. R1, R2, C4 and C6 are timing components and relate to the operation of the decoder. Note that separate sets of +V and 0V power rails are used for the radio frequency (RF) and audio frequency (AF) parts of the circuit, and these are separately de-coupled. The AF and RF sections may be linked at the power supply input.

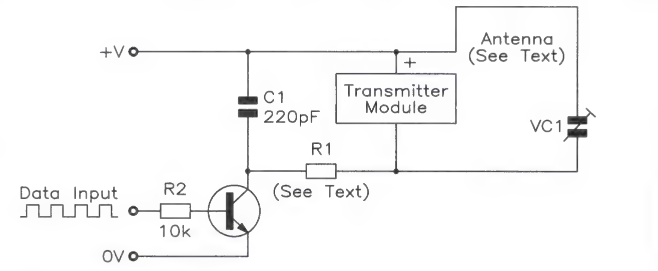


Figure 5.

The circuit shown in Figure 8 is slightly different. This time, IC1 treats all 9-bits as address data providing a larger number of code combinations. If the address data received on pin 9 of IC1 corresponds with the code set on the IC's address lines, then pin 11 switches to a logic high state. If an error occurs or the incoming code ceases, then pin 11 returns to a logic low condition. This type of arrangement is useful in radio keys and other security applications where only a momentary pulse is required as a trigger when the correct code is received. All of the above circuits allow the use of trinary addressing with some limitations. For details of this, readers are referred to the IC data sheet.

As mentioned, the use of code IC's means that your circuit will only produce a valid output when the decoder receives the code that it is set to respond to. Bearing in mind the operating range of the RF link, the probability of another user, in close proximity, inadvertently transmitting the same code that you have set your system to is very small indeed (though, of course, not impossible).

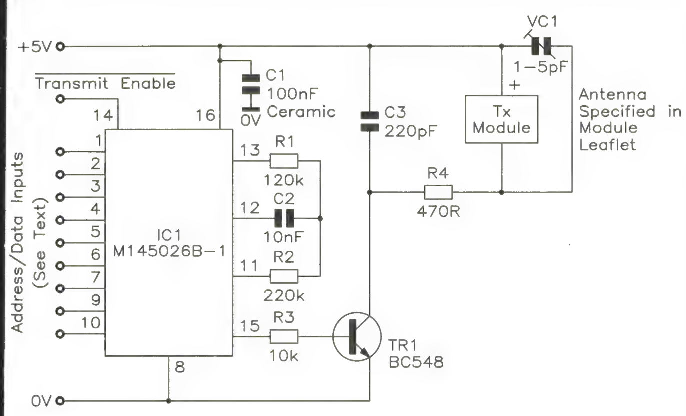


Figure 6.

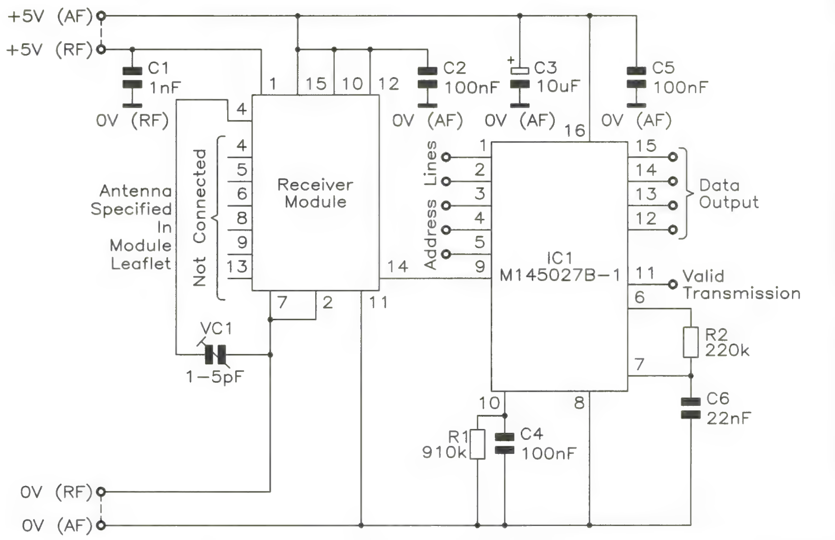


Figure 7.

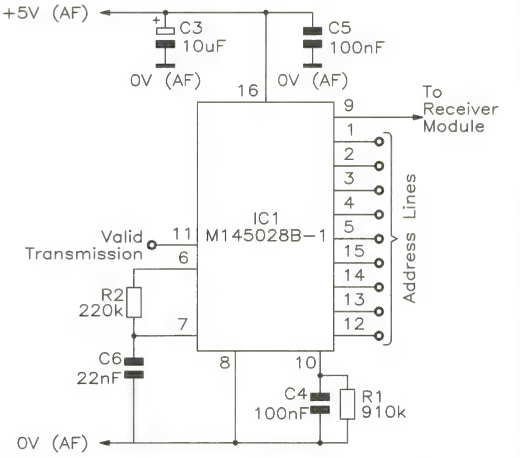


Figure 8.

Not just remote control

As well as using the modules in remote control or telecommand applications they are also extremely useful for transmitting data from remote sensors etc. This is known as telemetry.

An example of this would be when used in conjunction with environmental sensors such as those measuring temperature and humidity. Often, it is necessary to mount these units in an inaccessible position requiring long and difficult cable runs. It is possible to use an RF link to transmit data from the sensors to a point where it may be processed. It may even be possible to power the sensors and the RF link from a lead acid battery charged from a local source such as a solar panel. This would obviate the need for an external power supply feed or other external wiring.

In order to use the RF link in this way, it is necessary to find a reliable method of converting the data obtained from the sensors into a form that can be readily transmitted over the RF link. Such a system should maintain the integrity of the data as far as possible, so as to reduce the probability of possible errors which may occur as a result of the conversion process.

When it is required to transmit data over a single channel link, it is necessary for the data to be in a serial format. A parallel format would clearly require more than one channel, and using a simple RF link this would not be very practical to say nothing of the RF spectrum such a system would waste. Positional sensors sometimes produce data in a parallel format. For example, rotational sensors may use a parallel system in the form of Gray code, a variation on binary. Conversion to a serial format must therefore be carried out between the sensor and the RF transmitter stage.

Many sensors produce data in analogue form. This usually takes the form of a voltage or current that varies with the parameter being measured. One of the easiest ways to transmit this sort of data over a simple RF link is to convert it to a digital code using an Analogue to Digital or A/D converter. A quick flick through the Semiconductors section of the Maplin catalogue will show that a wide range of 'off the shelf A/Ds are available. These usually allow analogue voltages to be converted into a digital code with a specific number of levels. The resolution is limited by the number of data bits used, with 8-, 12- and 16-bit types being readily available. The degree of resolution that you require will very much depend on the application. A/D converters are available with data outputs in serial or parallel format. If the A/D converter outputs parallel data, it will, of course, be necessary to convert this to a serial format for transmission over the RF link so the appropriate device should be chosen carefully.

Referring to Figure 9, another method that produces data in a serial format is voltage-to-frequency conversion. This usually takes the form of a voltage controlled oscillator that has an output frequency which is linearly or logarithmically proportional to the input voltage. The maximum resolution of this type of circuit is mostly determined by the accuracy and stability of the oscillator. If the voltage to frequency characteristics of the oscillator are not strictly linear or logarithmic, or if the oscillator suffers from a high degree of frequency drift due to environmental conditions, this will compromise the accuracy of the system. Other similar systems are based on transmitting a train of pulses which vary in width or position dependant on the input voltage. These methods are known as pulse width or pulse position modulation respectively.

At the receiver end, the transmission is detected and demodulated, reproducing the frequency to the transmitter. Care must be taken to ensure that unacceptable inaccuracies are not introduced when the data from the receiver is processed. There are a wide variety of methods to convert the received data back into a useable form. These vary from simple analogue filter and diode pump circuits to microprocessors running complex software depending on the application and the accuracy required. Digital to analogue conversion is a complex subject and to discuss all of the options in detail is outside the scope of this article.

For a group of sensors in close proximity, it would be sensible to arrange the circuit so that it sequences through the sensors one-by-one. This would avoid the need for additional transmitters. When the data from one sensor has been transmitted, the circuit would automatically switch to the next sensor and so on. This can often be achieved using standard logic chips such as analogue switches and decade counters.

Where it is necessary to use separate transmitters, steps must be taken to prevent two or more transmitters sending data at the same time, as this would result in loss or corruption of the received data.

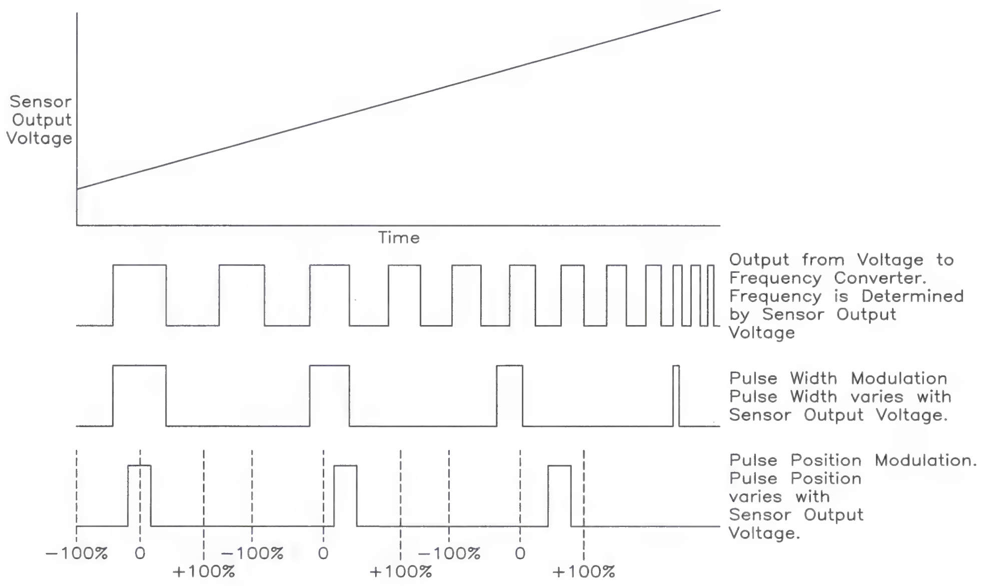

Sensor Output Voltage
Time
Output from Voltage to Frequency Converter. Frequency is Determined by Sensor Output Voltage
Pulse Width Modulation Pulse Width varies with Sensor Output Voltage.
Pulse Position Modulation. Pulse Position varies with Sensor Output Voltage.
−100%
0
+100%
−100%
0
+100%
−100%
0
+100%

Figure 9.

Security Applications

A common use for the 418MHz band is in relation to in-building security. Wire connections that would normally be made between alarm sensors and the main control unit can be replaced by a radio frequency link. Modules of the type described in this article are ideal for use in this type of application. Each sensor unit would be locally connected to an encoder/transmitter circuit. This would transmit the relevant data to a receiver module located close to or inside the main control panel.

It is necessary to use an appropriate encoder and decoder with the transmitter and receiver modules, firstly to provide a degree of security and secondly to identify different sensors or groups of sensors. It is also possible to control the arming and disarming of an alarm system; this could be by use of a small handheld transmitter.

Like most things, wireless alarm systems have both advantages and disadvantages. The advantages relate to ease of installation and operation. The main disadvantage is that it is often much harder to provide the same level of anti-tamper protection with a wireless alarm as you can achieve with a properly installed wired system. However, it is possible to provide a good level of security with a wireless system if it is properly designed.

A problem with the majority of simple wireless alarms is that if the operating frequency is jammed and the sensor is removed, the control unit will continue to operate as if everything is normal, failing to notice the missing sensor. This problem can be overcome with some additional cost by either polling the sensors from the main control unit or by transmitting a 'heart beat' signal from the transmitter unit.

Polling is the more complex and costly of the two methods to implement, as the control unit and each sensor requires both a transmitter and receiver. Typically, the main control unit sends a code to each of the sensors at regular intervals and in turn the sensor transmits a code back to the control unit indicating its status. If the system is jammed or the sensors are removed, the main unit detects the absence of the return code transmission and can be set to respond accordingly.

It is possible to reduce the overall cost by using a partially wired system. All of the sensors in a local group would be wired to one transmitter/receiver, using the appropriate interface circuitry. This transmitter/ receiver would then communicate with the main control unit over an RF link, transmitting the status of all of the sensors in that group. This arrangement is shown in Figure 10.

If only one sensor is in use, a simpler method is to arrange for the sensor to transmit a 'heart beat' code at regular intervals. If the control panel fails to detect this code for a predetermined period, this indicates that the sensor is not in operation and therefore that the system may have been tampered with. It can be arranged so that the control panel either provides a tamper indication or that the alarm is triggered.

Heart beat circuits can also be used to detect the unauthorised removal of equipment or valuables. This relies on the fact that low power radio links have a limited range. When the transmitter is moved out of range of the receiver, the heart beat transmission is no longer detected, triggering the appropriate alarm condition. When the radio link is being used in this type of application, it is often sensible to deliberately reduce the range of the transmitter and/or the sensitivity of the receiver. This can be achieved by appropriate siting of the transmitter and receiver modules and by use of smaller, less efficient antennas.

There are many different variations on this type of circuit and the above descriptions are purely intended to point you in the right direction.

Some intruder alarm sensors, by their very nature, produce only a momentary pulse when triggered. Vibration sensors typically fall into this category. It is therefore necessary to provide some type of latch or retriggerable monostable between the sensor and transmitter circuit, so that when a trigger event occurs, the output is maintained long enough to allow the necessary data to be transmitted. Some sensors may already provide an option for momentary or latched output.

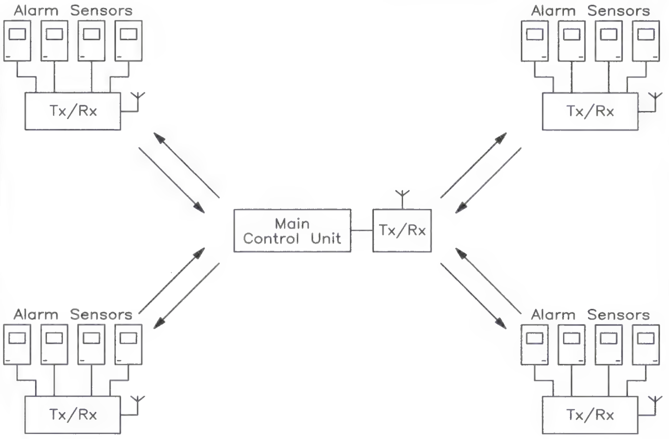


Figure 10.

Room for Experimentation

For those that like to experiment, there is also the possibility of transmitting more complex data such as images captured by security cameras. There are wide bandwidth microwave links which are capable of transmitting video images directly but these are relatively expensive. With some experimentation, it should be possible to capture a frame of video and store it locally in memory. The image data would then be clocked out of the memory at a slower speed within the 1200 baud data rate limitation and transmitted over the 418MHz link. At the receiver end the image would be reconstructed in a similar way to a standard facsimile. This type of system would, of course, require considerable development. Obviously each frame would take some time to transmit and there are important issues relating to synchronisation which would need to be looked at.

Coming up next month...

We have covered some basic ideas and points to be borne in mind when using the 418MHz modules. Next month we will look at some actual experimental circuits you can build.

Calling ALL CARDS

Alan Simpson looks at the exploding world of telephone cards.

The origins of the payphone, and in turn the exploding world of telephone cards, dates back to 1884. This was when the Postmaster-General took the important decision to allow telephone companies to set up 'call offices' or telephone stations available for the use of the public. At the time, there were only around 13,000 phones in use, and these were confined to 75 towns and used by large firms and well-to-do households. It was thanks to that decision that a whole sector of society, to whom the new technology was largely only a rumour, was allowed access to the telephone.

It is worth remembering that BT currently operates over 140,000 public payphones – from remote Welsh villages to airport terminals. On the private rented side, there are over 200,000 units in use in bars and hotels, plus an equally impressive number of payphones in private households. But that is not all, as anyone trying to walk through cluttered City centres will note, rival phone companies such as New World, with over 8,000 phone boxes, and Interphone jostle for space with BT.

But before the present era of the good, bad and downright ugly telephone kiosks, much development has taken place. By 1906, people were becoming familiar with the term 'silence cabinets' which were equipped with a handset (the receiver and speaking parts were separate), a coinbox and a set of instructions. All calls had to be made by the operator, and paid for in advance. Prepayment boxes were not introduced until 1925 which freed the role of the operator in collecting fees. Kiosks even then were judged to be unsightly and had to remain inside buildings.

A milestone in the development of public payphones was reached with the introduction of the 'Button A and Button B' prepayment coin box in 1925. This allowed the coins to be deposited into the cash box and the call transmitted. If a call could not be connected, or if there was no reply, callers pressed Button B to get their money back. The mechanism was originally designed to check the presence of two pennies by a weighing operation. It was set to a minimum acceptable weight for the coins as a safety margin, but as the fee was gradually increased to 3d and then 4d, the safety margin became smaller and eventually unacceptable. To overcome the problem a new mechanism was devised which checked three pennies by weight, and waited for the insertion of the fourth penny before allowing the call. The system required little additional equipment but it could not be adapted for an increase beyond four pence.

The first versions of 'pay-on-answer' phones were introduced in 1959 followed by a radical move to electronics in 1985. This was when BT embarked on a £160 million programme to replace the much admired red phone boxes and the old pay-on-answer mechanisms with the modern blue payphone. Today, the UK's public payphone service is fully electronic and all dial models have been replaced by push-buttons. These phones allow you to pay by cash, Phonecards, BT Chargecard and credit cards, in fact almost everything except barter. They can be managed by computer remotely with sensors automatically reporting all faults affecting service, when a problem such as a blocked coin occurs. In addition, the usage of each phone can be logged and analysed as well as keeping tabs on regular fault incidents. Certainly, the move towards cashless calling has led to a major cut in crime against payphones in recent years

But in this day of mobile phones, just how important are payphones? 'Very' seems to be the answer. It appears that the familiarity of mobiles and pagers has made us all aware of the need to keep in touch. Mobile phones, according to those who know about these things, have a fragile and ironically 'public' quality which you don't find in a pay booth, which is stable, solid and semi-private. Apparently, these factors can affect the way we speak and the subjects we choose to talk about. Mobile phone users are on record as saying that they use their mobile for brief, keeping in touch calls and 'I want you to know how busy I am' type calls, to more relaxed 'I've got all the time in the world to talk' calls – and presumably, plenty of phone cards and/or cash!

From Optical To Microchip Technology

BT Payphones, along with all other payphone operators, is moving from optical to microchip card technology together with running high profile trials of Mondex, electronic cash in the form of rechargeable payment cards. Other BT developments include dataport payphones and payfax. Here airport lounges are being equipped with dataport payphones where travelling executives can plug in their laptop computers or fax machines, slide their credit card into the phone's swipe reader and send the information back to base.

So what exactly is a phone card? According to industry expert Ralph Adam, unlike a stamp or a coin, it can be anything: pre-paid stored-memory (magnetic, holographic, electronic, inductive, etc.) pre-

Photo 1. New generation phone cards - collectable items?

Photo 2. The New World advanced payphone.

paid remote memory; and post paid. But it can also be a credit/debit card or anything else that links in to telecoms networks. Phone cards were first introduced in Italy in 1976 – although their pre-history goes back over a hundred years to telephone stamps and tokens which served much the same function. The earliest IC cards appeared in the 80's and were soon followed by promotional (advertising) cards – and the explosion of issues that resulted.

Collectors of the World – Unite

Over the past ten years says BT, phone card collecting has become one of the world's fastest growing hobbies – there are thought to be between two and four million collectors world-wide. Research conducted in France estimates that 20% of the population collect something – stamps, pins, cards, coins – and that four in five are men. Owing to the wide range of phone cards available throughout the world, new collectors tend to specialise in certain areas of interest – i.e. some collect BT internal cards, others Disney cards, whilst some collect along themes of transport or scenery. Other matters of fact from BT include the news that in Japan, 50% of cards sold are never used, and that the most valuable card ever produced by BT is now worth £2,500 and marks a golf tournament in Scotland. At the same time unused mint cards command a greater price, and obviously those cards with a lower production run or with an accidental error are more valuable than general issue cards. BT's own collectors club – Phonecard Direct – has over 5,000 members who regularly purchase cards. It is estimated that there are 80,000 collectors in the UK and the majority of these collect used cards.

A good example of the 'celebrity' card was that recently issued by First Telecom which featured Gary Barlow, the Take That personality. This particular venture is being run in conjunction with The News of the World, Vodafone and the well know publicis Max Clifford. Probably the organisers are hoping to emulate the premiums enjoyed i the US when a $1,000 Elvis Presley card has changed hands at $400,000. Though given that the winning best card produced last year in the annual Cardex Awards Scheme, 'Two Sheep Swooning' from NZ Telecoms, somewhat more inventive cards win the industry prizes.

At the same time, pre-paid mobile cards are experiencing high growth. In fact the recent GSM conference in Cannes, South France (nobody ever stages a major conference it seems in Milton Keynes or Eastbourne) could well have been designated the Pre-Paid GSM Conference with companies such as Tandem Computers, Motorola , Nokia (whose beach party featuring the Lennigrad Cowboys stunned al present and most residents along the Med coast), Hewlett Packard, and Bosch Telecoms dominating the proceedings.

New Age Phone Cards

Last year saw the arrival on the UK scene of pre-paid phone cards from Norweb Communications who have linked with the high charged US Teleservice Group Smartalk. Available from authorised outlets in units between £1 to £20, the cards rather than holding the appropriate number of units purchased which are then deducted from the card each time a call is made are second generation cards. These differ from the earlier types in having the value of each individual card held in a central switching unit rather than in the card itself. Users access the service by dialling an 0800 number followed by a PIN (Personal Identification Number). If the PIN number is valid, the user then continues to make the call.

It is no wonder that the pre-paid phone card market is generating a lot of heat with companies such as Interglobe, New World, TCS, First Telecom, Worldcom International and World Telecom making much of the running. As international card producers Landis & Gyr and Gemplus can rapidly confirm. In fact the Eurodata team recently claimed that the European market for telephone cards is currently worth over US$3 billion and likely to rise to US$ 4 billion by the year 2000 with most of this growth coming from increased use of prepaid remote memory cards. In the US, the value will reach US$570 million by 2000, an increase of some 857% in just three years!

Certainly the new generation of phone cards are backed by very high powered technology. New World claims that digital communications platforms are revolutionising the way our phone calls are handled and the speed and volume of calls which can be processed at any given moment. The large telecoms companies are investing in bigger and better platforms to ensure that their customers not only get fast call response, but that value added services

Photo 3. New World offer an alternative to the more common BT public payphones.

re also available such as voice prompts, oice and fax mail services, message elivery, pre-paid telephone card recharging nd interactive platform and database unctionality.

In essence, a platform is a network of omputer hardware which consists of a omputer acting as a central data source to number of other computers which answer nd process calls. A telephony platform is onnected directly into an operators etwork via E1-T1 trunks which carry calls o and from the platform using an ppropriate protocol e.g. DASS2 or C7 SS7). Any call bound for the platform hich originates from an ITFS (international oll free service) will be routed via the etwork operator to the platform in a anner which carries set-up information to he platform by directing the call to specific DI, and dictates what application to start unning. This ensures that a pre-paid card older receives the appropriate voice rompts to action out their call.

During the call, there are several points of nteraction where the user is requested for nput which is achieved by DTMF signals dual tone multi-frequency). The data eceived during this interaction is validated y the central data base and dictates the low of the call. New World claim evelopments in platform technology are ast moving, and it will not be long before peaker independent voice recognition, llowing for the comprehension of a range f dialects, and database interaction are ommon factors of telephony life.

So for most callers, phone cards are good news, but maybe not for hotel operators who often do their best to make life difficult if not impossible for card callers. For users, the main choice ingredient is for cheap telephone calls. But pre-paid card suppliers will have to stay on their toes if they want to remain competitive. Soon the Internet and Smart cards with *e-purse* facilities will offer attractive alternatives – phoning home will not only be easier, it will also certainly be cheaper.

Win a Phone Card

But don't take our word for it. You have the opportunity to win a New World payphone card. We have one £10 card, two £5 and seven £3 cards to award to the first ten all correct answers drawn out of the editor's venerable hat received for our competition 'Calling all Cards'.

All you have to do is to complete the coupon, correctly answering the four questions, or send your answers on a postcard or back of envelope. Don't delay – all entries must be received by 30th June 1998. Send your entry, remembering to include your name and address, to the address printed on the coupon.

Please note that employees of Maplin Electronics, associated companies and family members are not eligible to enter. In addition, multiple entries may be disqualified. The prizes will be awarded to the first all-correct entries drawn. The editor's decision will be final. Prizes are not exchangeable for cash.

CALLING ALL CARDS COMPETITION

Answer all the questions below, ticking one box for each question.

1. Certain phonecards provide additional services. These include:
- ☐ Ability to send fax mail
- ☐ Provide an automatic hot line to The Spice Girls.
- ☐ Allocate free World Cup tickets

2. Most cards include a card number/ personal identification number. How many numbers can the average person remember:
- ☐ 2
- ☐ 10
- ☐ 77

3. When was the BT Chargecard introduced?
- ☐ 1902
- ☐ 1930
- ☐ 1988

4. Which is the most dynamic market for telephone cards?
- ☐ Finland
- ☐ Guadaloup
- ☐ USA

Name ....

Address ....

....

....

.... Postcode ....

No purchase is necessary. Entries on a postcard, back of sealed-down envelope, or photocopies will be accepted. Send your entry to:

Calling All Cards Competition, The Editor, Electronics and Beyond, P.O. Box 777, Rayleigh Essex SS6 8LU.

Science Line

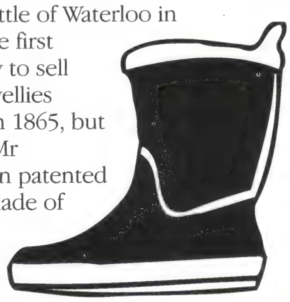
A selection of the most popular questions that people ask

Why doesn't lightning and thunder occur at exactly the same time?

Thunder and lightening always occur together in a storm. But the light from the lightening travels faster than the sound from the thunder so the light reaches you first. The speed of light is 300 thousand metres a second while the speed of sound is only 340 metres a second (or 761 miles an hour). Light travels so fast it reaches you almost instantaneously while the sound trails along behind. It takes about five seconds to travel one mile so by counting the number of seconds between the lightning and the thunder, you can calculate how far away the storm is.

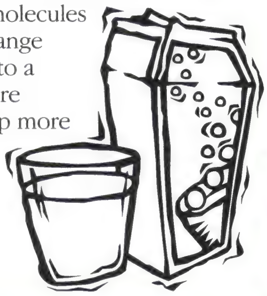
When was the wellington boot invented?

Legend has it that the wellington boot was specifically invented for the Duke of Wellington. But it is more likely he just popularised the style. The first wellington boots were leather and used at the battle of Waterloo in 1815. The first company to sell rubber wellies started in 1865, but in 1857 Mr Lochigton patented a boot made of rubber and leather.

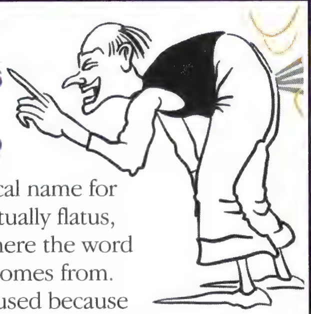


Why does milk expand when it is cold?

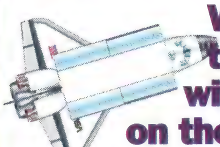
Milk is actually mainly made up of water which expands when it freezes. This is because the molecules in water rearrange themselves into a crystal structure which takes up more space than the normal, liquid structure of water.



What makes 'farts' smell?

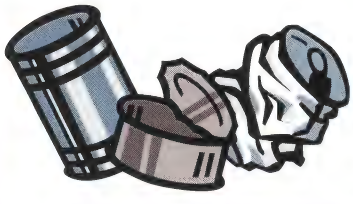


The technical name for a 'fart' is actually flatus, which is where the word flatulence comes from. Flatus is caused because the large intestine ferments undigested food, releasing the gases nitrogen, carbon dioxide, oxygen, methane and hydrogen sulphide. The last three are produced in quite small amounts and it is the methane and hydrogen sulphide which cause the smell.



What do they do with rubbish on the Shuttle?

Bring it all back, including what is in the toilet! – although urine which is often dumped overboard. Rubbish is carefully stowed in containers and NASA is developing a 'trash-compactor' which, like a scrap yard squasher, will reduce the size of rubbish in the confined space aboard the orbiter.



Why does shaking a bottle of fizzy drink make it fizz when you open it?

Fizzy drinks are full of carbon dioxide – the gas that makes them fizz. This gas is dissolved in the drink like sugar in a cup of tea. However, it gradually leaks out and collects in the small space between the bottle cap and the drink – called the head space. Usually, when you open a bottle of drink, this gas can escape easily and you often hear a slight psssht. But when you shake a bottle, this undissolved carbon dioxide gets mixed up in the drink forming pockets of carbon dioxide. When you open the bottle, these pockets rocket to the top of the bottle taking some of the drink with them. This drink then flows out over the top of the bottle.

ABOUT SCIENCE LINE

Science Line was started in March 1994 during the first science week, and is an educational charity funded by the National Lottery, Welcome Trust, the Royal Society, OST (Office of Science and Technology), some of the research councils and Channel 4.

Telephones are staffed by science graduates from various disciplines, and if we are stuck for an answer, we have a database of 1000 experts who have volunteered to help us out. We can be contacted on the number shown below (calls charged at local rates), and our lines are open from 1pm to 7pm Monday to Fridays.

Just over 60% of all calls are answered on the day, with the rest normally within a week – after adequate research.

The average age of all callers is 28, with 64% of callers being male. 35% of questions are physics or astronomy related, 35% biology or medicine related, 10% chemistry, and the rest on environment, engineering, technology, geology and allied subjects.

Tel: 0345 600 444

Software HINTS & TIPS

by Mike Bedford

This month I'm going to guide you through the graphic file form jungle to help you differentiate your TIFFs from your JPEGs.

If you use graphics or desktop publishing packages, you're probably familiar, in name at least, with a vast number of graphic file formats. GIF, TIFF, JPEG, BMP, WMF, DRW, CDR, EPS, AI – the list seems never ending, and to many PC users this is a source of some considerable confusion. So how does one graphic file format differ from another? If your graphics package supports lots of different formats should you stick with its native format or export to a more 'standard' format? And how do you convert files from one format to another? Let's take a look.

First of all, it's appropriate to consider why there are so many different formats. To a degree it's a case of companies devising their own format with no regard to what other companies were doing or to standardisation. However, this isn't the only reason for the proliferation of formats – different formats are sometimes designed for different purposes. The most fundamental difference is between raster or bitmapped formats and vector or object oriented formats.

A bitmapped file contains the colour of every single pixel in the entire image. As such, it's ideally suited to photographic images and will be the type of file produced by scanning a document. Generally speaking, bitmapped files take up a lot of space, although the size doesn't depend on the image complexity and, if you forget compression, it's pretty easy to work out how large a file will be for a given resolution. However, the bad thing about bitmapped files is that you can't scale the image without either loosing information (if you reduce it in size) or introducing 'jaggies' (if you increase it in size). They're not easy to edit either. Actually, that's not strictly true – it's easy to make adjustments to a photograph such as increasing the contrast or eliminating a colour cast, but it's not easy, for example, to move a line in a technical illustration.

An object oriented file contains information describing each of the objects which make up the image. So, for example, it may contain the co-ordinates of both ends of a line, its thickness, its colour, and details of any 'dashing' pattern. Similarly, it may contain information about the font, point size, colour and contents of a text object. So, the size of the file will depend on the complexity of the graphics – there's no way of working out how large it will be although, except for very complicated images, they'll normally be smaller than a corresponding bitmapped file. Object oriented files may be scaled without loss of information or the introduction of 'jaggies' and they're easy to edit. Object oriented graphics packages (generally called drawing packages as opposed to paint packages which handle bitmapped files) allow you to select and modify each object individually.

One other difference concerns compression. A number of graphic file formats have built-in compression but there are two distinct methods of doing this. Some use so-called lossless compression which means that compression doesn't affect image quality. Others use a lossy compression mechanism in which information is lost. When you save an image in this type of format you have to decide on the compression ratio. If you pick a large number you get a small file but a poor quality image whereas, if you pick a small number you end up with a large file and a better quality image.

Choosing a Format

Using the information we've seen so far in conjunction with the table, you should be able to start to make some decisions about which format to use. If you're handling photographs use a bitmapped format and if you're working with technical illustrations, use an object oriented format. If you want a high quality result stick with lossless compression whereas if it's more important to have small files, go for lossy compression. But even so, there's still a lot of choice so what should you use?

First of all, save your files in your graphics package's native format. So, for example, if you use Corel Draw, save your work as a .CDR file. This way, you'll know for sure that the file format supports everything in your drawing. However, if you picked another format this may not be the case. To take an extreme example, some early formats didn't support colour so if you picked this type of format, you'd loose all your colour information.

However, there is a case for using a more standard format if you're sharing data with others. For example, whereas .CDR is now relatively standard in the realm of PCs, it is much less so with MACs or UNIX boxes. But rather than saving your work in a more universal format, a much better solution would be to save it in the package's native format and export to another format as a separate exercise as and when necessary.

Converting Files

Talk of exporting in a different format brings us to the topic of file conversions. An obvious way of doing this is to use a graphics package with an extensive repertoire of supported formats as an intermediary. Simply import in one format and export in another format. But beware, especially in the realm of object oriented formats, that you may loose some elements of the image depending on what features the formats support.

Alternatively, you can buy packages specifically for converting between graphics formats and some of these are available as public domain or shareware offerings. As a final comment, you should be aware that you can convert from object oriented to bitmapped but not vice versa. Actually that's not strictly true since some object oriented formats support bitmaps as objects, but really, this is just disguising a bitmap as an object oriented drawing. 'Objects' such as lines or text within the bitmap obviously don't become individually editable.

That's all for this month. We already have a number of topics lined up for the coming months, but if you have anything you'd like to be covered, do drop us a line.

Extensions	Type	Descriptions
.AI	O	Adobe Format – proprietary format.
.BMP	B	Windows Bitmap – Windows & OS/2. Optional lossless compression (not particularly high compression ratio).
.CDR	O	Corel Draw – proprietary format.
.DRW	O	Micrographx – proprietary format.
.DXF	O	Data Exchange Format. Developed by Autodesk for AutoCAD.
.EPS	O	Postscript – a printer format.
.GIF	B	Graphics Interchange Format – efficient lossless compression. Used for images on the Web.
.JPG, .JPEG	B	Joint Photographic Experts Group – features lossy compression. Used for photographs on the Web.
.PCD	B	Kodak PhotoCD – stores images at a range of resolutions within one file.
.PCX	B	Created by Xsoft for PC Paintbrush – now a general purpose format. Optional lossless compression.
.TIF, .TIFF	B	Tagged Image File Format – optional lossless compression.
.TGA	B	Targa – one of the first formats to offer 24-bit colour. Optional lossless compression.
.WMF		Windows Meta-file – can be used as either an object orientated or a bit mapped format. No compression.

Some Common File Formats (O = object-orientated, B = bitmapped)

Weighing TECHNOLOGY

PART 2

Past and Present

Douglas Clarkson looks at modern day weighing technology in the concluding part of his series.

Electronic Weighing Technology

The evolution of electronic weighing systems has resulted in the weighing process being much more rapid and with the potential of greater accuracy. In electronic balances, two main technologies are essentially used – that of the load cell for low to intermediate accuracy and force motor systems for intermediate to high accuracy. Force motor systems are almost exclusively used for high precision in laboratory type applications.

As with any measurement technology, as the resolution of measurement increases, this is also associated with the increasing chance of measurement error. However, the very best endeavours of modern electronics coupled with refinements of mechanical structures has relentlessly driven down the contribution to errors associated with the weighing process. Additionally, there remains a core of good practice to ensure that methods and environmental conditions do not degrade the potential accuracy of the modern high precision laboratory weighing systems.

Precautions with stability of work surface relate principally to the degree of accuracy of the work required. Laboratory balances are typically described as, for example, a two place balance, or a three place balance as indicated in table 6.

Balance Description	Resolution
ONE	0.1 g
TWO	0.01 g
THREE	0.001 g
FOUR	0.0001 g
FIVE	0.00001 g

Table 6: Relationship between balance description and balance resolution for laboratory balances.

Thus a balance which indicates 3.672g would be described as a 'three place balance.'

The weighing surface should transmit as few vibrations as possible. While the user environment affects all balances to some extent, consideration of local vibration usually becomes a concern from three place balances and above, so that for a five place balance, the degree of accuracy of readings will be largely dependent on the physical stability of the measurement surface.

Generally within work areas, the corner areas provide the most rigid work places. Balances should not be exposed to direct sunlight or drafts from windows, doors or cooling fan outlets of other equipment. The temperature variation of the measurement area should be minimised. It will also help i the balance is always left switched on. It is important to ensure that the balance is correctly centred using the bubble-in-circle indicator, otherwise the correct component of the loading force will not be correctly applied to the weighing platform.

Moisture Gain/Evaporation

The very nature of the sample, however, ca cause changes in mass to be detected. A hydroscopic sample such as dried silica gel can absorb water from the atmosphere and hence show a weight gain. Conversely an open necked vessel containing a liquid sample such as water is prone to evaporation. The latter effect can largely be countered by using a narrow necked vessel.

With balances of high resolution, effects begin to be manifested due to other factors One of these is due to temperature differences between the flask and the interior air of the balance. Where the flask is at a higher temperature air will rise over the flask and appear to make the sample lighter Conversely, with the flask cooler, air will tend to be cooled against it and as a result

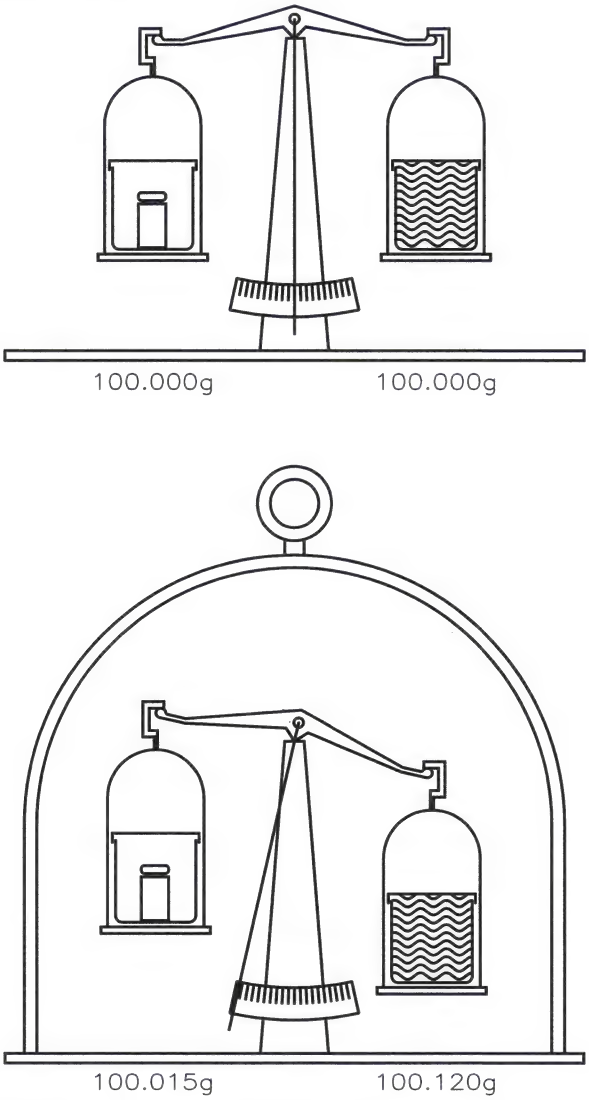


Figure 5. A demonstration of the static buoyancy effect of air.

Calibration	Weight	Water
Weight in air	100.000g	100.000g
Density	8000.00Kg/m^3	1000.00Kg/m^3
Volume	12.5cm^2	100.00cm^3
Buoyancy of displaced air	0.015g	0.120g
Weight in vacuum	100.015g	100.12g

Table 7: Relative value of buoyancy effects in weight of analytical samples.

all since it is of greater density – leading to an increase in the flask weight. In practice, it s advisable that samples should be allowed o acclimatise to laboratory temperatures before being weighed.

Electrostatic Effects

Where the flask becomes electrostatically charged with reference to the balance pan, forces of electrostatic attraction or repulsion can operate – thus causing an error in observed values. The use of plastic weighing vessels, where the relative humidity is less than 45% can increase the likelihood of such effects being introduced. If the flask has acquired a negative charge relative to the upper area of the balance housing, it can lead to a downward force on the flask. Conversely where the flask has a positive charge, it will experience an upwards attractive force. In general, plastic with low conductivity presents more of a problem than glass and the best function is generally found with metal weighing vessels. Plastic vessels tend to be widely used since they are cheap, lightweight, and can be partly transparent for observing fluid level.

Static Buoyancy

Most weighing is undertaken without consideration of the static buoyancy effect of air. As an example, a calibration mass of 100g placed on a balance in a beaker and balanced with a 100g of water in an identical beaker as indicated in Figure 5. If the masses are compared in a bell jar with the air removed, then the arm with the water, the less dense subject, will appear heavier as indicated in table 7.

The correction for air buoyancy can be described for practical purposes as:-

$$m = R(1-a/8000)/(1-a/d)$$

where m is the true mass, R is the balance display, a is the density of air and d is the density of the sample. It is assumed that the density of the calibration mass is 8000 Kg/m^3.

The top line component can be considered to arise due to the fact that the effective mass of the calibration weight is less than its stated value due to buoyancy effect, and without this correction, the balance will be over reading the value. The term on the bottom line is indicating that the actual indicated mass of the sample will be less than its true weight due to buoyancy effects.

In an example, for a 200g mass weighed in air with a density of 1.2029Kg/m^3 and with sample density of 2.6g/cm^3, the true mass of the sample would be 200.0625g – an error of 0.03%. This level of error is usually not corrected for routine work and is identified as a systematic error. For weighing very dense materials such as gold with a density of 19300 Kg/m^3, a true mass of 200g would indicate 199.9824g with the same air density value. These effects are well known and can be corrected for if required. However, for balances with high resolution these intrinsic errors of buoyancy are much greater than the intrinsic accuracy of the balance itself.

Gravity Variations

The centrifugal acceleration on the surface of the earth tends to produce a component of acceleration away from the centre of the earth – like the force experienced on a roundabout in motion. The component of this force is greatest at the equator and acts against the force of gravity, and has a typical value of 0.0337m/s^2- compared with the nominal acceleration due to gravity of 9.81m/s^2. At the poles, the component of centrifugal acceleration is effectively zero. This factor tends to provide for an increased value of g at the poles compared with the equator. There is also a small component due to the fact that the poles are slightly flat which also tends to increase gravity slightly there though the difference of only 22km between equatorial and polar radius implies a relatively small effect.

Of more significance is the effect due to the height of the balance above the earth – with the force of gravity depending on the inverse square of distance of a mass from the centre of the earth. At an elevation of 1000m, the value of acceleration due to gravity will be some 0.03% less. Using the same logic, it can be shown that a balance which is calibrated to indicate 200.0000g at one level of a building will register 199.9993g if it is raised up 10m. For a 1000m change in level, the 200g mass would indicate 199.93722g – a difference that would be easily detected using balances of relatively low resolution. This is why it is important that balances are always calibrated using weights of appropriate accuracy at the locations where they are used. If this is not done, then significant errors can be introduced. There can also be local variations, due for example to the proximity of mountain ranges.

It is always assumed, that while the value of the acceleration due to gravity varies with latitude and with height above sea level, its value will be essentially static at a given location. There will be a range of effects which will introduce barely detectable effects due to the orbit of the moon around the earth, the motion of the tides on the surface of the planet and the change in air density in the atmosphere.

The moon's orbit round the earth is actually elliptical with its distance from the earth varying between 363,000km to

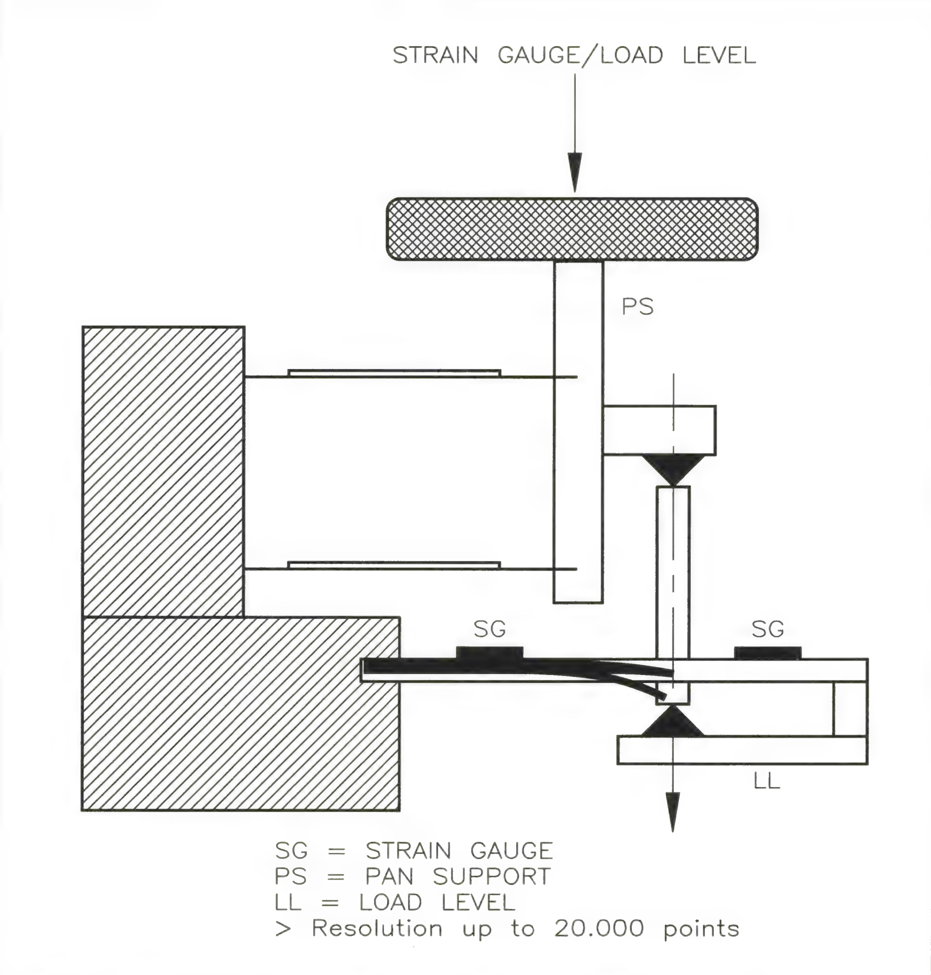


Figure 6. Theory of strain gauge/load cell technology weighing systems.

Photo 10. A range of load cell devices used in a wide range of industrial weighing applications. (Courtesy Avery Berkel)

406,000km. With a few simple calculations, it is possible to indicate that the change in mass reading of a 200g mass calibrated at closest approach to a measurement made at furthest approach is of the order of 0.00015g. However, it is only as balances have been made more sensitive that the possibility of detecting these effects has become possible.

Electronic Measurement Technology

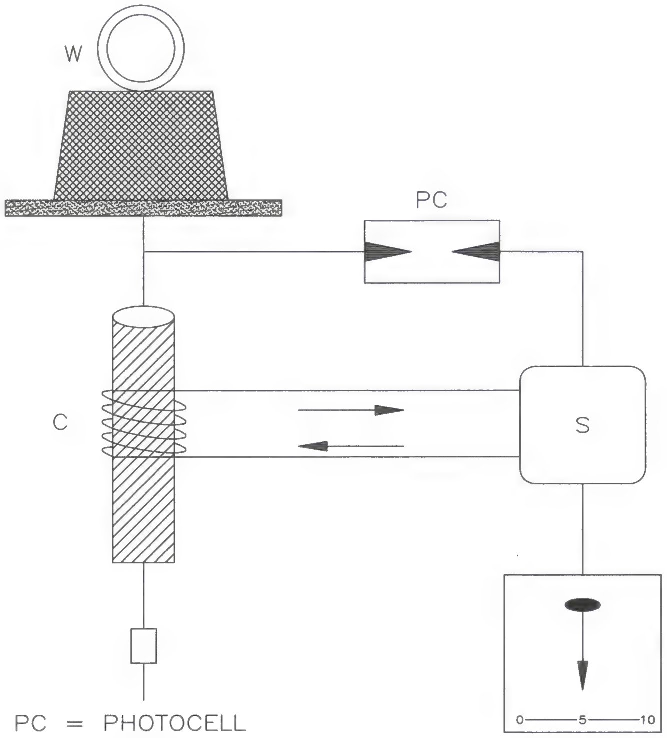
It was from the 1970's onwards that heralded the introduction of electronic means of measuring weight. One of the complications of this technology was the fact that an electronic system involves making a comparison with a reference calibration, which had been assumed to have been undertaken at the same point of measurement. With the previous systems of conventional balances, where the force on the fixed known mass was equal to that on the unknown mass, this implied that at balance the value of mass measured was independent of the force of gravity. Such a conventional balance could have been used quite successfully on the moon to weigh unknown masses as long as the unknown mass could be balanced exactly by a known mass. It is important therefore, that electronic balances should be calibrated at the location they are used. Such calibration can be by use of externally applied weights or internally loaded types – the latter a feature of a so called 'verified balance'.

By far the largest number of weighing devices use strain gauge/load cell technolog A resolution of 1 in 20,000 is typically possible Such a sensitivity could, for example, be used to weigh 0 to 20Kg on 1gm divisions o 1 to 20 metric tonnes in Kg divisions.

The basic principle of the load cell is indicated in Figure 6. The downwards force on the pan support (PS) applies a force across a lower support on which is placed two strain gauges. The relative deformation of the two strain gauges increases as mass i loaded onto the pan. The signal from the strain gauge is amplified accordingly. The signal response of the strain gauge has a component of non-linearity which is compensated for in each individual balance by a customised linearisation function whic is typically built into its firmware.

A key feature of the design of such load cell structures is the design and manufactur of the associated physical structures of the assembly. This has a key role in determining the intrinsic stability and repeatability of measurements. Thus no matter how advanced the electronics may become, there will always remain a crucial role for good mechanical design. Photo 10 shows a range of load cell devices used in a wide range of industrial weighing applications.

In the analytical balance, typically required for resolution of 1mg and higher, a different weighing technology is used namely electromotive force compensation, as indicated in Figure 7. Resolution of one part in 5,000,000 is typical of higher order o resolution of such devices – corresponding, for example, to weighing 500g with a resolution of 0.0001g.



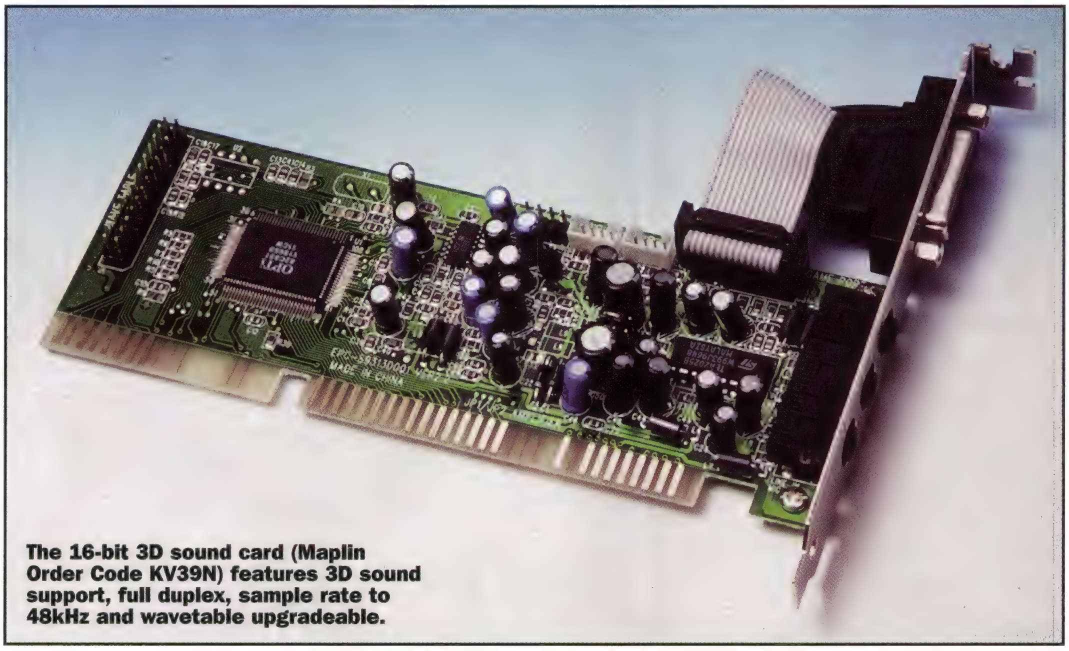
PC = PHOTOCELL
C = COIL
S = REGULATOR
W = WEIGHT
> this principle allows the highest resolution

Figure 7. Analytical balance using electromotive force compensation for a resolution of 1mg or higher.

Sound Card TECHNOLOGY

PART 2

by Mike Bedford



The 16-bit 3D sound card (Maplin Order Code KV39N) features 3D sound support, full duplex, sample rate to 48kHz and wavetable upgradeable.

Last month we laid the foundations for an in-depth look at PC sound cards by investigating the technology involved in synthesising musical instruments. Specifically, we looked at how FM, wavetable and physical modelling synthesis work. This month, we'll present an overview of sound card hardware, explain the various facts and figures which are quoted by the manufacturers and help you to decide which sound card is most suitable for your application. We'll also look at associated equipment such as speakers and surround sound set-ups.

Introducing the Sound Card

If you were to ask a PC user what a sound card does, the most likely response would be on the lines of "it generates sounds". Although this is undoubtedly true, it can generate sound in a number of different ways, it performs other tasks associated with sound manipulation, and it probably does a number of other jobs related to multi-media and games. So the first job in our investigation of the sound card is to describe exactly what it's designed to do. You may like to refer to the high level block diagram (Figure 1) of a sound card as you read through this section. I make no guarantees that any actual sound card will follow this diagram exactly, but it should help you to understand the descriptive text.

Sound Reproduction

So let's start off with the most fundamental and obvious function of the soundcard, namely generating sound. The first method of generating sound is simply by converting digitally sampled sounds to the analogue domain. This digital audio data may be stored on the PC's disk, a CD-ROM or the Web as a .WAV file, or it may be routed from an audio CD in the CD-ROM drive. Clearly, this makes use of little more than the card's DAC – its digital to analogue converter. In this mode of operation, the only function of the sound card is to convert digital data to analogue audio, so absolutely any sort of sound can be reproduced.

The second method of generating sound is by synthesising musical instruments. Most current cards contain both an FM and a wavetable synthesiser, some bottom-end cards only offer FM synthesis, and forthcoming cards will also provide a physical modelling synthesiser. We'll look at the pros and cons of each of these methods of synthesis a bit later but for now, we'll concentrate on those aspects which are common to all synthesisers. The purpose of a synthesiser is to play music on simulated instruments, taking the instructions from a midi file. Unlike the .WAV files which contain a full description of the sound, midi files just contain high level commands such as 'play middle C on a piano accordion for one second'. The files are, therefore, much smaller than .WAV files but the exact sound produced depends on how well the sound card can synthesise each instrument. Furthermore, the repertoire of sounds is more limited – only those instruments supported by the sound card (or are downloaded to it) can be played.

The third source of sound from a sound card is its microphone and line inputs. Analogue audio signals presented at these sockets will be mixed with the other audio signals and passed through to the card's output. This may be used, for example, in karaoke applications, or with hardware such as a PC radio card which needs the facilities of a sound card to route its output to the speakers.

Output Circuitry

Most, but not all, sound cards include audio amplifiers, typically providing a 4W output. However, a few budget offerings, especially those OEM products which are supplied as part of a complete PC system, omit the audio amplifier providing output at line level. These cards can be used only with the so-called active speakers, that is, speakers that have in-built audio amplifiers inside their cabinets. However, even if a card does have an audio amplifier, you don't have to use it as there is usually a line output too. This is the output you'd used with powered speakers or to attach an external higher quality amplifier and speakers. A few sound cards also give the option of taking the output at an earlier stage still – before the DAC. Now, of course, the output is digital rather than analogue audio, and this output would have to be routed to an external DAC and audio amplifier. This approach would be used to give the ultimate in reproduction quality. The final bit of output circuitry found on some cards is 3D signal processing. Using a DSP, this circuitry produces a pseudo surround sound effect through just a pair of speakers.

Sound Sampling

The second major function of a sound card can be thought of as the reverse of reproducing digitally-sampled audio. Any audio signal presented at the card's microphone or line input can be sampled using the on-board ADC and the resultant xternal tester as required.

Furthermore, if a digital oltmeter is connected across he 'E' and 'B' 'output' erminals during gain neasurements it will measure he voltage drop - normally bout 200-300mV for Ge and round 600mV for Si devices.

Start by drilling the box nd fit all the hardware omponents. Wiring is point-to-oint using either single strand r thin multi-strand hook-up vire. Alternatively, coloured bbon cable can be use. The ransistor connections are by ying-leads emerging through a rommet. Ideally these three eads should be sleeved as they ast through the grommet, and dditionally held with a tie-wrap or improved reliability. Heatshrink sleeving on all witch/connector terminals will lso add to reliability.

Testing

After adjusting your multimeter, et S1 (if fitted) to external, and onnect a meter probe to one ransistor lead in turn and in ach case verify zero Ohms to he corresponding terminal and o reading to the other two erminals. Now set S1 to nternal and connect one meter robe to each transistor lead in urn and the other probe is ouched to the other two ransistor leads and to each erminal. In all cases there hould be no reading.

Now connect the meter robes to their respective ockets on the transistor tester nd short the three 'E', 'B' and C' crocodile clips and confirm here is no reading - whether np or npn selected (S2), and ll other switches at neutral. Remove all shorts except EB nd confirm that there is a full cale deflection when selecting n turn S3 (EB leak) and S4 (EB orward current). All other witch conditions should give o reading. With S2 selected to he opposite polarity, repeating he test should produce the ame result.

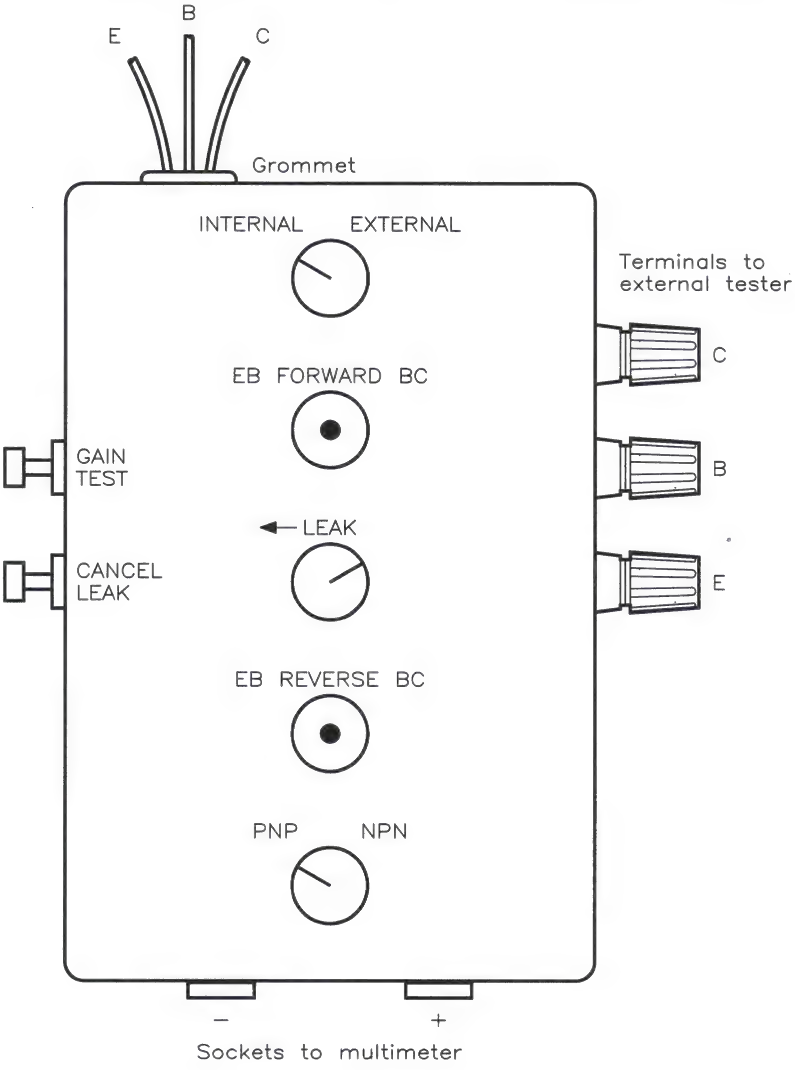


Figure 2.

Remove all shorts and onnect a known, good silicon diode across EB with cathode connected to the 'B' lead and set S2 to pnp. With S4 in EB position there will now be a forward current measurement. Now switch S2 to npn, and S4 in EB position, forward mode no longer indicates a reading, but S3 in EB reverse does indicate a reading. Reverse the diode so that the cathode is now connected to 'E' lead, now S4 to EB will show conduction, but S3 to EB does not. Set S2 to pnp and S3 to EB which will conduct and S4 to EB which does not. Remove the diode.

Now short the BC leads, and with S3 in BC, S4 will show full deflection when in both forward and reverse. With S2 in alternate position, repeat this test which should indicate the same result. Remove the short and connect diode with cathode to 'B' lead and anode to 'C' lead, then with S2 set to pnp, S3/BC does not conduct but S4/BC does. With S2 to npn, S3 and S4 give the opposite readings. Now turn the diode round, for original readings. S2/pnp gives opposite readings once more. Remove the diode and connect across EC leads with cathode to 'C'. S2 set to pnp will show conduction if S6 held on, and with S2 set to npn conduction will stop - S6 still held. Turn the diode round, and conduction returns with S6 held but ceases with S2/pnp - and S6 still held. Remove diode.

Remove meter probes, and connect to 'E' and 'B' leads, then press S7 for full deflection; pushing S5 should give no reading. Reversing the meter probes should give the same results. Now connect meter probes to 'B' and 'C' leads, and press S5 for full deflection. Pressing S7 should give no reading. Reversing meter probes should once again give the same result.

The final test is to connect the meter to the sockets again and test good known examples of transistors to confirm that the tester works.

PROJECT PARTS LIST

S1	4-pole SM Toggle	(FH08J)	optional
S2	Sub-min toggle E	(FH04E)	
S3,4	Sub-min toggle H	(FH07H)	
S5,7	Push switch	(FH59P)	
S6	Sub-min toggle K	(FF71N)	
Box	BM11 ABS Box	(CC81C)	
Ext Skt	Small Terminal Post Yellow	(FD74R)	optional
Ext Skt	Small Terminal Post Green	(FD71N)	optional
Ext Skt	Small Terminal Post White	(FD73Q)	optional

Probe Skt	2mm Socket Black	(HF44X)
Probe Skt	2mm Socket Red	(HB47B)
Clip	Croc Clip Yellow	(FK35Q)
Clip	Croc Clip Green	(FK36P)
Clip	Croc Clip White	(FK37S)
Grommet	4mm Standard Type	(JX64U)
Tie Wrap	Type 100	(BP91Y)
Covers x 3	Min Toggle Covers White	(RA96E)

In addition, various lengths of coloured hook-up wire, heat shrink sleeving, transistor socket holders (WR29G), sleeving,

Quick & Simple TRANSISTOR TESTER

Godfrey Manning explains how to construct a simple switch box which can be used to check all those spare transistors lying around.

Faced with a pile of 'surplus' mainly germanium transistors, I had to test them quickly to select those good enough for maintaining my vintage wireless collection. This tester was developed to exploit the ability of an analogue multimeter to test semiconductor junctions when the Ohms range is selected. Reverse leakage and forward current flow are qualitatively indicated so that you can separate working devices from defective ones. The tester is a simple switch box - the multimeter plugs in one end and the transistor at the other. Flicking the switches performs a comprehensive test of the transistor. See Figure 1, circuit diagram.

Operation

S3 tests reverse leakage of emitter/base (EB) and base/collector (BC) junctions. One multimeter probe is switched to 'B' and the other is switched to either 'E' or 'C'. When connected in the reverse sense, that is negative (usually the red probe) to 'B' for NPN devices, should produce no reading for silicon (Si) devices and a tiny reading for germanium (Ge) devices. Some 4-legged Ge types, such as the AF117, do have large reverse EB current flows.

S4 tests forward conduction for junctions EB and BC, with an operation similar to S3, but with direction reversed (positive to 'B' if NPN). This should produce a good reading. An indication of gain can be made with EB forward biased by S4, and BC shorted by S5 which results in more current flow.

For EC forward leakage, S6 correctly connects 'E' for normal operation, that is negative if the device is NPN, and 'C' to the other multimeter probe. There should be zero reading for Si devices and a small leakage reading for Germanium types. This should drop to zero if EB is simultaneously shorted by S7.

Polarity switching is by S2, and it may be necessary to adapt the input terminals to suit your particular multimeter, Most meter probes fit 2mm sockets, and it is worth remembering that most moving-coil multimeters really do give a negative output on the red probe.

The tester does not check for leakage on four legged devices where the extra lead is connected to screen/case such as an AF117. Obviously this can still be checked conventionally with a multimeter. However, it is worth noting that such devices are prone to deteriorate with ag - the leakage current increases regardless of the condition of th device, unused or otherwise.

Construction

It is worth providing three options for connections to various types of transistors. A flying-lead with crocodile clip - one each for 'E', 'B', 'C', a transistor holder/socket for wire-ended devices and a dedicated socket for TO-3 power transistors. For convenience, I added a further three terminals on the side of the box which can be used to connect to an external tester e.g. gain measuring device. Thi helps to minimise connecting and re-connecting a device under test. S1 is a 4-pole (only 3-poles used), 2-way changeove switch to divert from internal t

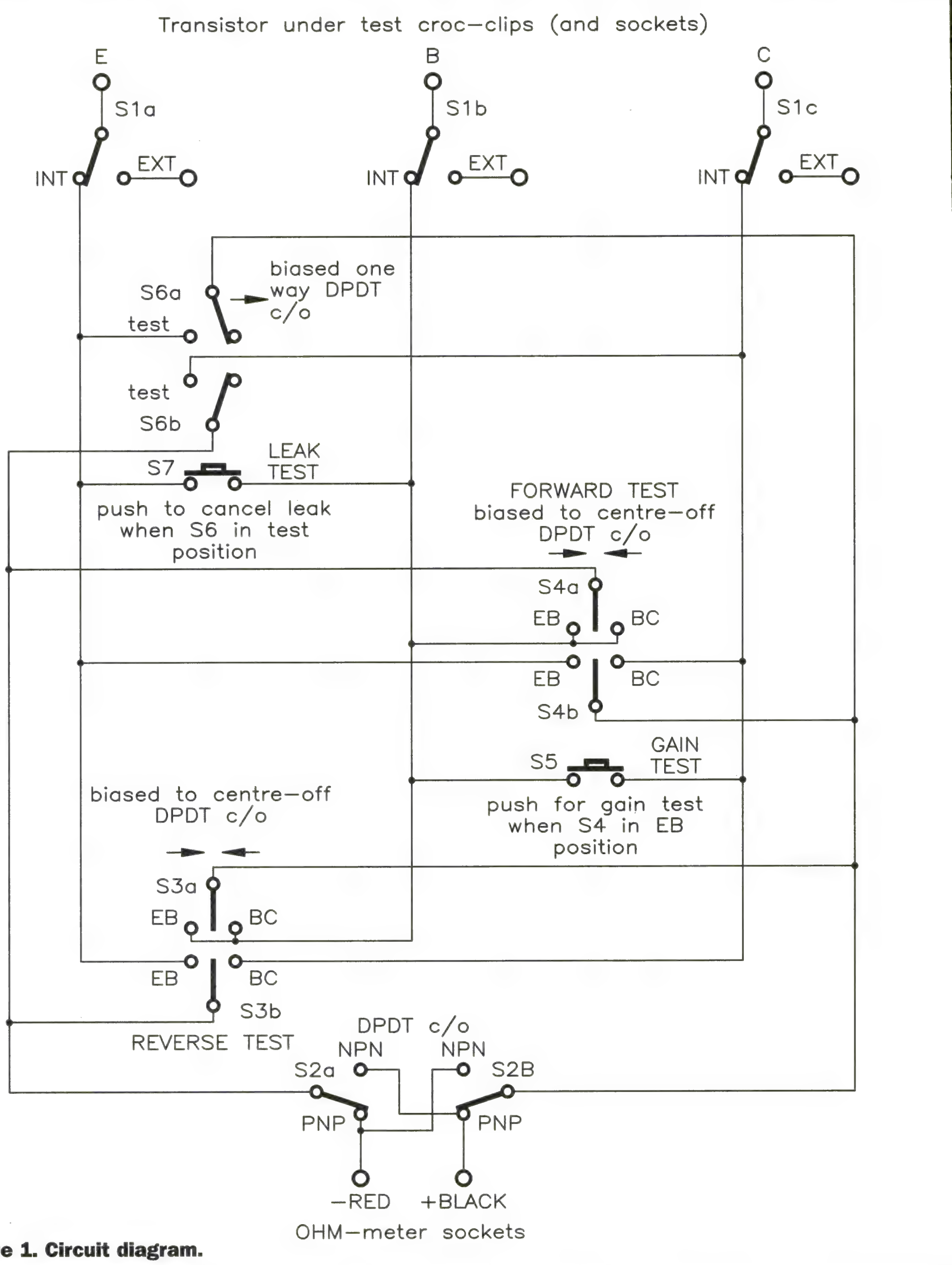

Transistor under test croc–clips (and sockets)
E
B
C
S1a
S1b
S1c
INT
EXT
S6a
biased one way DPDT c/o
test
S6b
S7
LEAK TEST
push to cancel leak when S6 in test position
FORWARD TEST biased to centre–off DPDT c/o
S4a
EB
BC
S4b
S5
GAIN TEST
push for gain test when S4 in EB position
biased to centre–off DPDT c/o
S3a
S3b
REVERSE TEST
DPDT c/o
NPN
S2a
S2B
PNP
–RED
+BLACK
OHM–meter sockets

Figure 1. Circuit diagram.

Photo 11. Range of both load cell and force motor weighing balances manufactured by Avery Berkel. (Courtesy Avery Berkel)

The weight communicated to the weighing olumn is compensated for by force in coil C, with sufficient current passing through he coil to exactly balance the force on the weight. The photocell C determines the point of equilibrium with electronic eedback of regulator S determining the alue of coil current required to achieve equilibrium. Although the basic principle is imple, the design of any such unit is considerably more complex than that of a load cell of comparable scale range.

Photo 11 shows a range of both load cell nd force motor weighing balances manufactured by Avery Berkel. In a very competitive marketplace there is continual drive towards improving performance and reducing or maintaining costs of systems.

Photo 12 shows a range of laboratory balances manufactured by Mettler Toledo – a specialist in high accuracy laboratory balances.

The Avery Historical Museum

The long association of manufacture of weighing equipment at the Soho Foundry ite in Birmingham is represented in part by he presence of the Avery Historical Museum on the premises of the current irm of Avery Berkel, part of the GEC ndustrial group. The museum, founded in 1927, houses one of the finest collection of weighing apparatus and machines to be ound anywhere in the world. Visitors are ery welcome to come and view the wide ange of exhibits. Tours of the museum however, require to be made by appointment.

Further Reading

The mechanical investigations of Leonardo Da Vinci, by Ivor B. Hart, University of alifornia Press, 1963

cales and Weights: A historical outline, by Bruno Kisch, Yale University Press, 1963.

A short history of weighing, by L. Sanders, very Berkel, The weights and measures of England, by RD Connor, HMSO, 1987

5000 years of development, by RM Cooper, GEC Review, Vol 9, No 3, 1994.

Issues of 'Equilibrium' published by The International Society of Antique Scale Collectors (see Points of Contact)

Weighing the right way with METTLER: The proper way to work with electronic analytical and microbalances, Mettler Toledo, 1989.

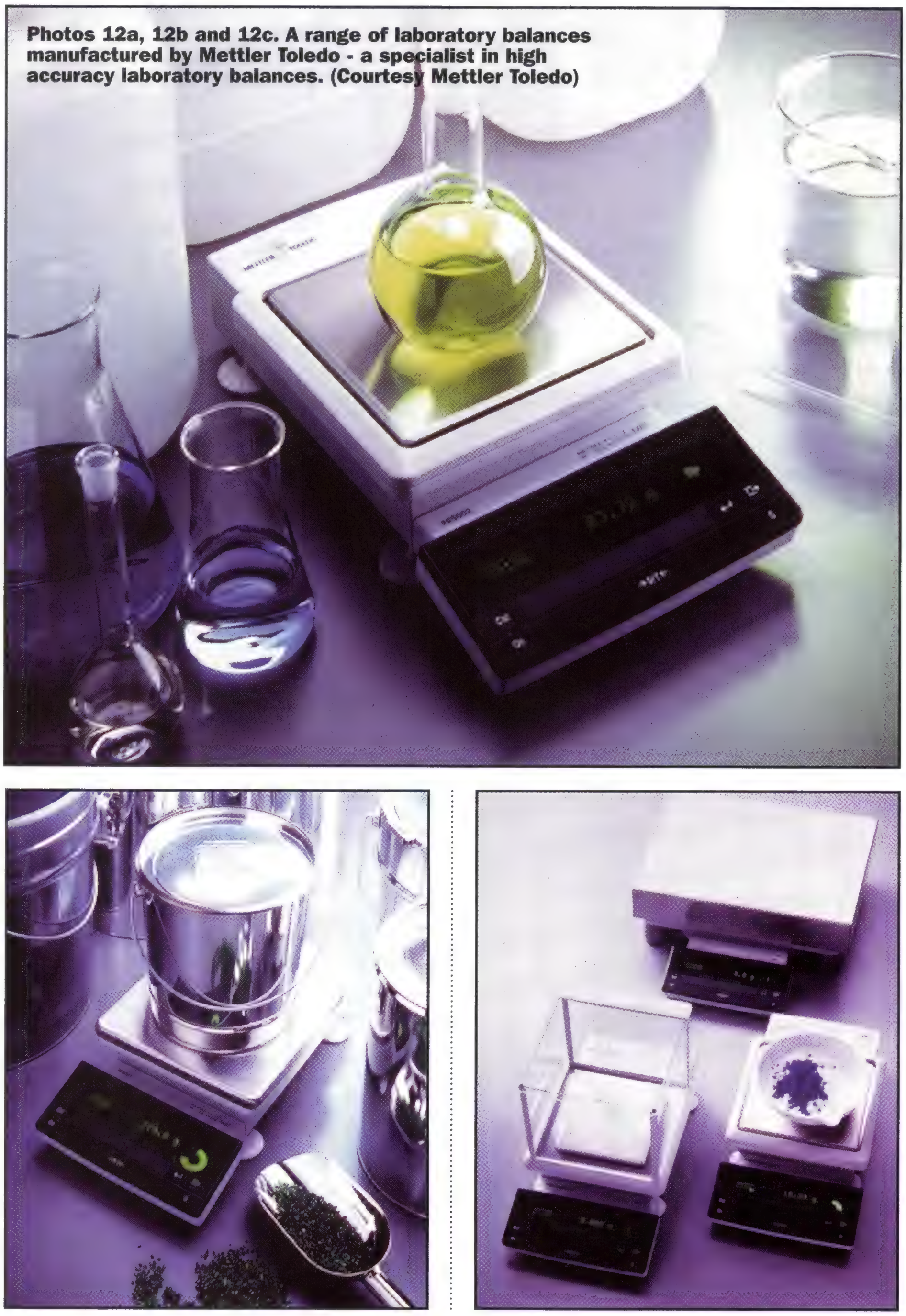
Points of Contact

The International Society of Antique Scale Collectors
Membership Enquiries
Ron Wilkinson, 28 Foxhill Road,
Burton Joyce, Nottingham,
NG14 5DB. Tel 01159 312480

Avery Berkel,
Foundry Lane, Smethwick, Warley,
West Midlands, B66 2LP.
Tel 0121 558 1112
(Contact for museum R.M. Cooper)

Mettler Toledo Ltd.,
64 Boston Road, Beaumont Leys,
Leicester, LE4 1AW. Tel 0116 235 0888

Photos 12a, 12b and 12c. A range of laboratory balances manufactured by Mettler Toledo - a specialist in high accuracy laboratory balances. (Courtesy Mettler Toledo)



The Sound Galaxy WaveRider Pro Soundcard. Maplin Order Code KX04E.

data written to disk as a .WAV ile. With many cards, the ynthesiser and audio CD outputs may also be sampled. Generally, cards offer a range of ampling frequencies up to 44.1kHz and will sample at either 8-bits or 16-bits.

Interfaces

The final function of a sound card is to interface to various peripherals which are related to the areas of multi-media, music and games. Just exactly what you'll find in the way of interfaces varies greatly from one card to another. The first interface – and this one is present on virtually all sound cards – is a MIDI interface. MIDI stands for Musical Instrument Digital Interface and we've already mentioned MIDI files in connection with synthesis. However, in addition to specifying a format for musical commands, the MIDI standard also specifies a hardware interface for interconnecting musical instruments, sequencers and computers. By using this interface it's possible to use the PC as a sequencer or, to play a MIDI file on an attached instrument as an alternative to playing it via the on-board synthesiser.

A second interface you may find on a sound card is a CD-ROM interface. And what we're talking about here isn't the interface for transferring data from an audio CD to the sound card – we've discussed that already – but the interface via which the PC will control and read data from the drive. The reason that this interface is often found on a sound card is largely historical. In the early days of audio on the PC, the sound card was often considered as part of a multi-media bundle, the other element being a CD-ROM drive. At the time, CD-ROMs used proprietary interfaces, so it made sense to put this interface on the sound card rather than take up two expansion slots. Although CD-ROMs are now mainly IDE devices, you still find an interface on some sound cards. Finally, another interface you might find on a sound card is a games port.

FM, Wavetable or Physical Modelling?

Having seen a basic overview of a sound card, it's now time to turn to the specification issues which you'll need to consider when you come to buy one. But before we take a look at the detailed specification, we need to consider one very fundamental question – what type of synthesis is best – FM, wavetable, or physical modelling?

As we saw last month, the characteristic sound or timbre of a musical instrument is defined by the relative amounts of the different frequencies or partials which are present in the signal. In fact, there will be an almost infinite number of partials but, in general, the amplitudes decrease with increasing frequency. What this means is that we can approximate to the timbre of an instrument by using just the most significant, lower frequency partials. Clearly, the more partials which are included, the closer the synthesised note will sound to the real instrument in question and eventually, we'll get to the point where adding further partials will have no noticeable effect. FM synthesis works by FM modulating one audio signal with another to generate harmonics, picking frequencies and amplitudes such that these harmonics approximate to the partials generated by a particular instrument. Clearly, therefore, FM synthesised signals aren't an exact representation, indeed, they often have a characteristic computer-generated sound. At one time, all sound cards employed FM synthesis, but today, FM-only cards are budget offerings. Nevertheless, if you're not interested in applications such as music or games, it could well be adequate. An FM-only card can still reproduce sampled sound effects as well as a wavetable card, and it can play audio CD quite acceptably. Only when it comes to playing MIDI files will its limitations become obvious.

In the wavetable approach, the method of synthesising an instrument is to play back sampled recordings of a real instrument which are stored in a ROM on the sound card. To a first approximation, therefore, the waveform will be perfect – no thought has to be given to partials, these will automatically be present in the samples. However, that statement has to be moderated somewhat. First of all, to save on ROM space, only occasional notes are stored, the gaps being filled in by playing back a nearby sample at a different speed to alter the frequency. Unfortunately, the waveform of an instrument varies over its frequency range so this only provides a close approximation. Secondly, the waveform of an instrument varies depending on how it is played. For example, on some instruments, the timbre varies with the volume. Once again, ROM size precludes storing samples for all eventualities and the result is an approximation, albeit a much closer one than with FM synthesis. Today, except for a few entry level cards, wavetable synthesis is the de facto standard. Since the price differential between the two approaches is now comparatively small, wavetable is the recommended technology for anyone who is serious about games or music. If you already have an FM-only card and want to upgrade, an alternative to buying a new sound card is to buy a wavetable daughter board. Many FM sound cards include a connector to facilitate this upgrade. However, do bear in mind that top-end wavetable cards probably have better DACs and audio stages than cheap FM-only offerings, so the daughter board upgrade often won't provide optimum quality.

The third approach is physical modelling, and here a processor exercises a mathematical model of an instrument to derive the waveform from the laws of physics. The advantage over wavetable synthesis is that changes in the way an instrument is played will automatically affect the sound produced and so the result will be much more life-like. In view of this apparent advantage over wavetable synthesis, you might find it strange that I recommended wavetable sound cards to serious gamers and music enthusiasts before even mentioning physical modelling. Well, the fact is that physical modelling is a new approach and one which, so far, isn't available in many sound cards. Certainly it shows every sign of being a major force in sound cards in the future, but today, you'd have little choice if you wanted a physical modelling card. Creative's AWE 64 Gold includes physical modelling as an option for some instruments, and Yamaha are in the process of launching both a software implementation of a physical modelling synthesiser and a hardware daughter board for their SW1000 sound card.

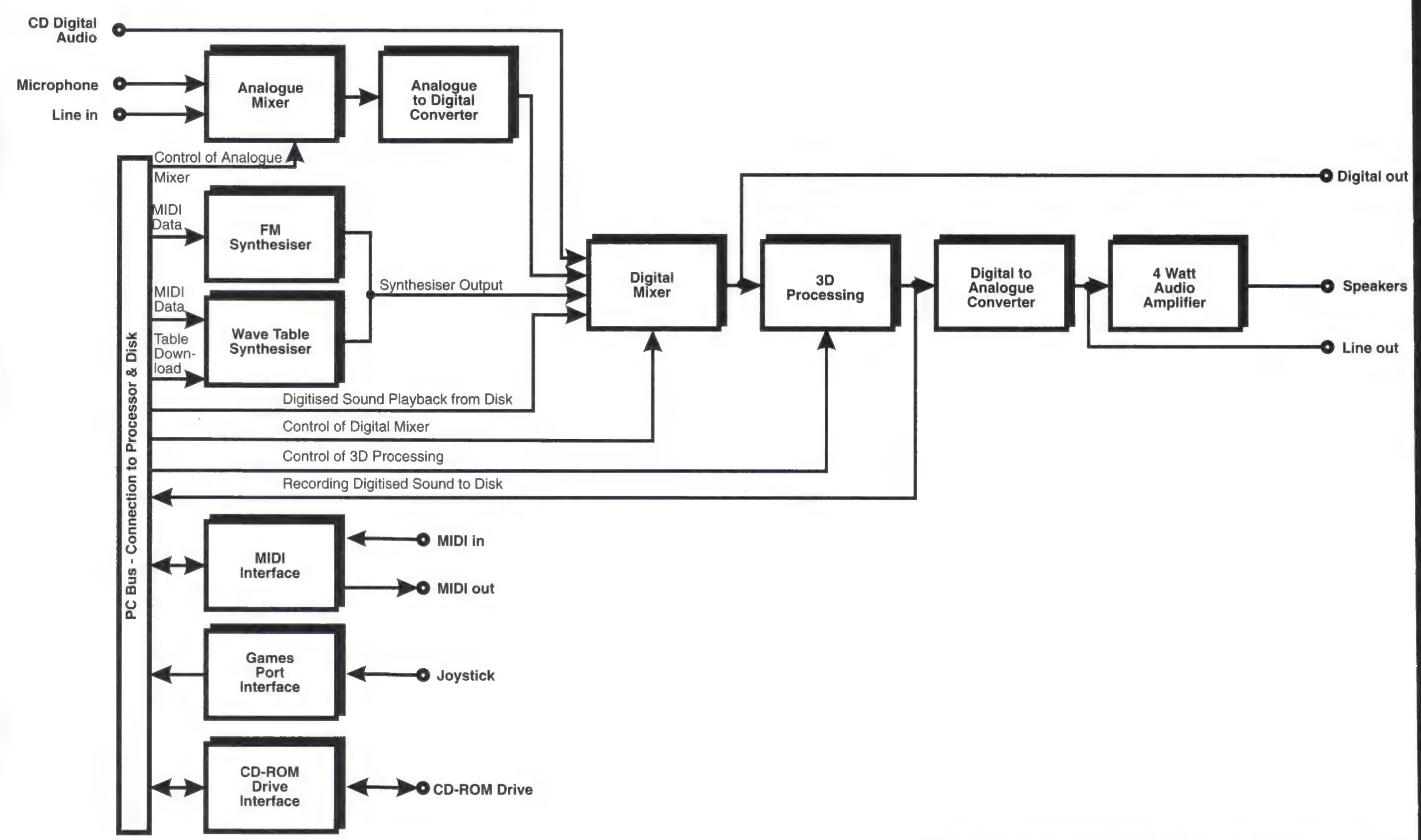


Figure 1. Block diagram of typical sound card.

Facts and Figures

If you decide on an FM-only sound card, then there's not a great deal you need to know about. Certainly that doesn't mean that all FM sound cards are identical (although many do use the same chipset) but if you choose one of these cards you're not too critical about sound quality so there's not a lot of point in looking at the comparatively minor differences which set them apart. If you decide on a wavetable card on the other hand, you're probably reasonably serious about sound quality and you'll find that there's a vast difference in performance between one card and another. Furthermore, a wavetable card is specified by a confusing array of facts and figures. So the first job is to take a look at the various figures which relate to wavetable sound cards and describe just what they mean.

The number of instrument sounds – or the number of voices as it's sometimes called – is the number of instruments stored in the wavetable ROM. 128 instrument sounds are required by the General Midi (GM) standard. In fact, the 128 sounds required by GM also includes percussion instruments which are treated differently from the other instruments. Many percussion instruments have no concept of pitch so when a drum is selected, an instruction to play a particular note such as middle C is meaningless. So rather than selecting a specific percussion instrument, a complete group of instruments is selected. Now, the 'note' information is used to select the individual percussion instrument from the group. A group of percussion instruments is called a drum kit, and contains about 60 percussion sounds. GM specifies a single drum kit, however, it is possible to substitute different drum kits, and the number of alternative kits is often quoted as part of a sound card's specification.

The number of parts multitimbral is the number of instruments which can be played at the same time. 16 parts multitimbral is required for GM compatibility. This figure is often – but not always – the same as the number of midi channels. A midi channel carries a stream of data to control any instruments on that channel. Normally, each instrument is on a separate midi channel. However, if a pair of instruments is assigned to a single midi channel, they will both play the same notes. Occasionally, you'll see a specification sheet refer to the number of notes multitimbral. This is confusing since the number of notes normally refers to polyphony (see next section), but if you see it prefixing the word "multitimbral", you can assume that it refers to the parts multitimbral.

The number of notes polyphony is the number of notes which can be played at the same time. This is not the same as the number of parts multitimbral since many instruments can play more than one note at once. GM requires at least 24 notes polyphony, but most sound cards offer 32. Once again things are sometimes confused by inexact terminology and some manufacturers talk about voices polyphony. By itself, the word voices usually means the number of instrument sounds but if you see it prefixing the word 'polyphony', it's reasonable to assume this is what is being referred to.

One other statistic which is nearly always quoted for a wavetable sound card is the ROM size in megabytes. Most people believe that this figure is the best measure of sound quality and whereas there is commonly a correlation, some caution is called for here. As we've seen, wavetable synthesisers sample some notes and fill in the gaps by stretching or compressing samples at playback. But since the waveform of an instrument varies throughout its range, this introduces inaccuracies. Clearly, the greater the number of samples which are included for each instrument, the more accurate the result but this will result in a larger ROM, hence the perception that more is better. However, other factors are involved. For example, the data in wavetable ROMs is often compressed using a lossy compression scheme in which there's a pay off between compression ratio and sound quality. But which is better – a few minimally compressed samples or a larger number of samples which have been subjected to a greater amount of compression? The other factor is the quality of the instrument recordings from which the digital samples were derived. Just as there are good and bad recordings of concerts, the same goes for wavetable samples. The end result is that its perfectly possible for one sound card with a 4Mbyte ROM to sound better than another with twice the amount of wavetable ROM. The answer, if you're serious about sound quality, is to draw up a short-list and audition those cards. As hi fi enthusiasts will tell you, in the final analysis it's what your ears tell you that matters, not the figures on the specification heet. Finally, in addition to the OM, some wavetable cards ave wavetable RAM. Now a ard's repertoire can be xtended by downloading dditional instrument sounds om the PC.

Associated Equipment

t's a surprising fact that many nanufacturers pay a great deal f attention to the quality and pecification of the wavetable ynthesis on a sound card, but omparatively little attention to he DAC and audio stages hrough which the sound has to ass. Similarly, many PC users o to the expense of buying a op-end sound card but loose ut by attaching it to cheap and nasty speakers. At first sight this latter comment may sound somewhat surprising in view of the high powered multi-media speakers which many PC users now buy, so a word of explanation is appropriate. Multi-media speakers differ from ordinary hi fi speakers in a number of respects. They're magnetically shielded so that they can be placed close to a PC monitor without causing colour impurity, they're small in order to save on desk space, and they have amplifiers built-in. These are all positive aspects, although it's pertinent to question how much of an advantage an 80W amplifier is when you're going to be no more than a couple of feet from your speakers. The downside of multi-media speakers is that they're usually designed by PC manufacturers rather than companies with a long established reputation for speaker design. Furthermore, if the user insists in buying a huge amplifier that he doesn't really need, yet the speakers have to meet certain price constraints, then the quality of the actual speaker will have to suffer.

For many people, these multi-media speakers are the best solution, given their magnetic shielding and small footprint, and in many cases, perfectly acceptable results can be achieved. Indeed, a few more specialist manufacturers of multi-media speakers strive for a high level of audio quality rather than a high level of power and some exhibit a good level of innovation, offering facilities such as pseudo-surround sound. However, for those who are serious about music, who can afford a bit more space and can separate the speakers from the monitor, then a much better solution is available. What I'm referring to here is ordinary speakers of the type intended for hi fi applications. With most sound cards it won't be worthwhile buying top-end hi fi speakers, but an entry level offering will far outperform most multi-media speakers with a similar price tag. The only snag, however, is that hi fi speakers don't have built-in audio amplifiers so you'd have to use the amplifier on the sound card. The 4W amplifier on most sound cards will be adequate for many applications although if it isn't – or if you've got a card with no on-board amplifier – then your only option is to use an external audio amplifier (see Figure 2). Certainly this adds to the cost, but the results could well be superb. If you want the ultimate in sound reproduction, you'd pick one of the cards with a digital output and add external DAC, amplifier and speakers. You should be aware, though, that this could end up being a seriously expensive system.

With the proliferation of Dolby Pro Logic encoded games and multi-media titles, surround sound is another add-on you might like to consider for your sound card. Given time, this facility will start to be included on the sound card but for now, it's an external option. Packages are available for the PC and consist of a decoder which occupies an expansion slot, plus five or six multi-media speakers. The comments we made earlier about multi-media speakers apply and if you want the optimum in quality, you'd be well advised to consider a non-PC decoder – the sort of set-up sold for home cinema use. These are just as applicable to PCs as to video recorders – the only difference is that you control it from the decoder box rather than from on-screen controls. Clearly, you could pay as much or as little for this sort of set-up as you wanted, but even at the bottom end, the results are likely to be superior to those products intended specifically for the PC.

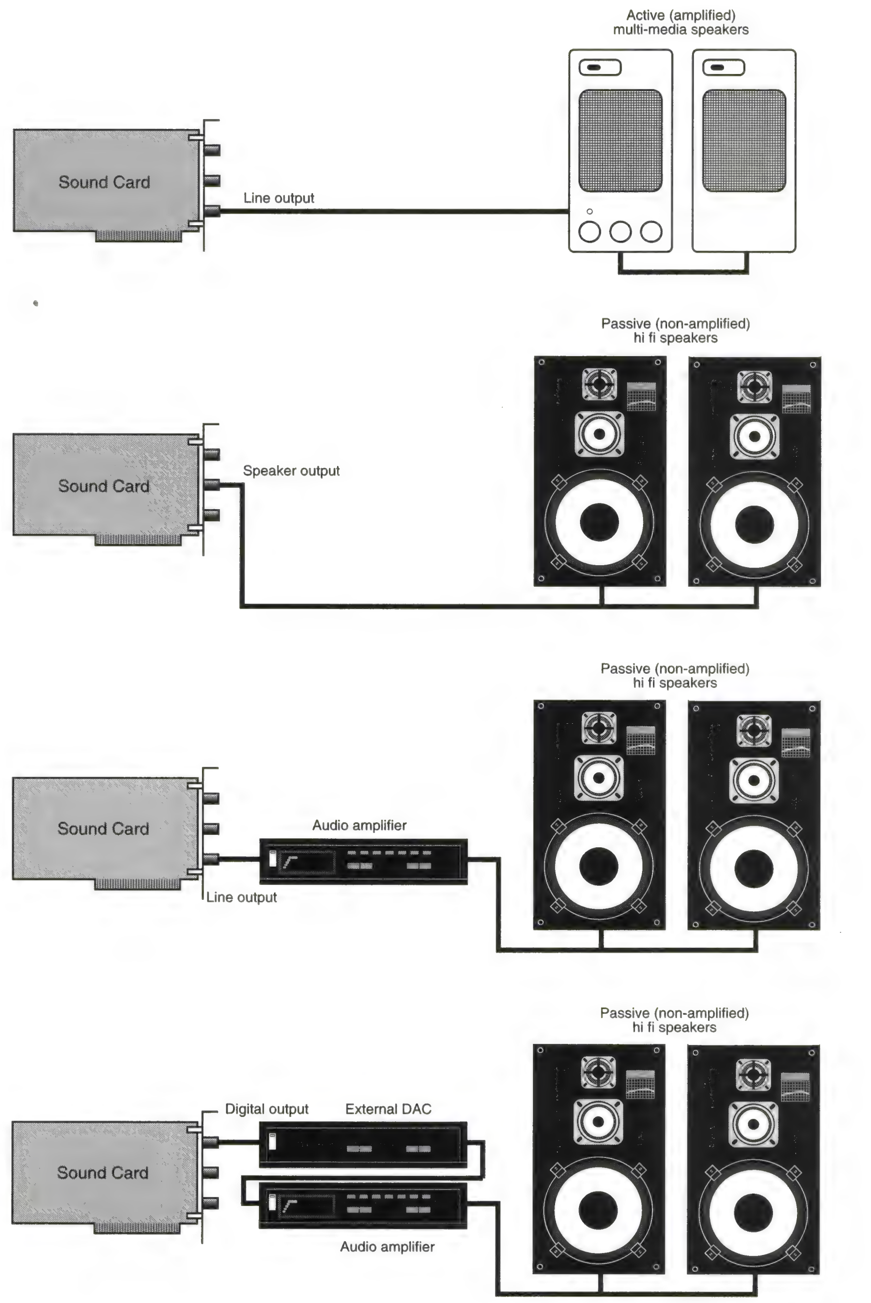
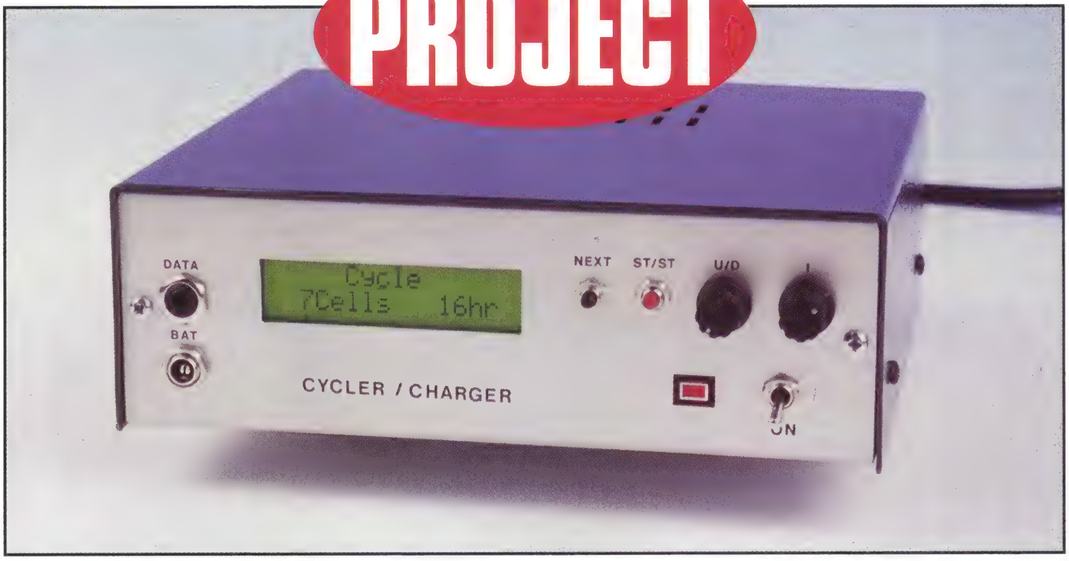


Figure 2. Various ways to improve the sound quality of your multimedia system.

See the Maplin Catalogue for a range of soundcards under the computer product section.

PROJECT



Intelligent Universal BATTERY CHARGER

Dr Mike Roberts describes a valuable project for all who use rechargeable batteries.

Introduction

This battery charger will be valuable to anyone who uses rechargeable batteries. It will handle most of the batteries used in model cars, aircraft and boats (up to 8 cells). The performance of the batteries can be seen simply by the display of the discharge time when cycling the batteries or in detail by downloading the voltage and current data to a PC.

Over the years I have accumulated (sorry!) rechargeable batteries of almost every imaginable capacity from 110mAhr to 2000mAhr. Hence, I needed a charger where I could set the current within a wide range. I had also nearly lost a radio controlled glider due to one cell in the receiver pack not holding its charge and I had an electric flight power pack which did not seem to be giving full performance. So I thought it would also be useful if I could record the discharge performance of the battery before charging. These were the drivers for designing a universal charger where I could optionally discharge any of my batteries to see what remaining charge was there (and avoid 'memory effect'?), and record the voltage/current during the cycle so I could examine the discharge/charge performance.

I hope that the design will also be of interest to those who are programming PIC microcontrollers. The alternative title for this article was going to be 'Yes you can fit a Quart into a Pint Pot!'. See the software and input/output design below. I had to use several techniques to squeeze the hardware (I/O lines) and software into a PIC16C71.

Software design

Input/Output

I start all my PIC projects with a check of how I will interface the PIC with the outside world. The first draft for this project was:

Analogue:

Battery voltage	1
Charge current	1
Discharge current	1

Digital

Display (8-data, 2-control)	10
Serial EEPROM	2
Serial link to PC	1
'Charge' output	1
'Discharge' output	1
Start-Stop input	1
No. of cells (binary)	3
Charge time (hex)	4
Total	26

The PIC16C71 I planned to use has 13 I/O lines. So I needed to save a few lines and use multiplexing where possible.

The first saving was made by running the display in 4-bit mode rather than 8-bit. This saves four I/O lines. The drive subroutine has eight more instructions and takes 10-20% longer to execute (including th time for the display to implement the instructions). The start-up code is also a little more complex. This is a small cost for a good saving in I/O lines.

For those who might want to use this 4-bit mode I have included the start-up and the control/data code in Listings 1 and 2. These listings can be compared to the 8-bit code in my 'Putting PICs to work Part 1' in issue 113 of *Electronics*. Note that PORTB bits 6, 7 are kept high as these are the 'charge' and 'discharge' outputs. Also, this code assumes the data is output on the lower nibble of port B. It can easily be modified for the upper nibble if required.

The next improvement came from deciding to enter the number of cells and the charge time using the same controls, prompted separately by the PIC. This saves three more lines but this was still not enough so I had to move away from binary/hex input and use 'up' and 'down' and 'next'. The total panel inputs are now four, including the 'start-stop' button.

This brought the total requirement down to 18 I/O lines. I then looked at some simple

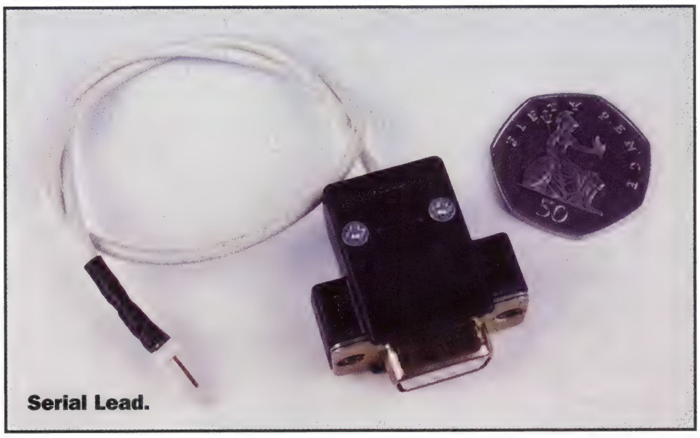
APPLICATIONS

Most of the common NiCd battery packs from 1 to 8 cells

Capacity 0 to 2500mAhr

Charge or cycle

Measurement of capacity


Serial Lead.

SPECIFICATION

No. of cells:	1 to 8 cell packs
Discharge/charge current:	0 to 250mA
Discharge:	to 1.1V per cell
Discharge and charge times displayed	
Charge time:	1to16hr (auto cut-off)
Data recording:	every 10mins (max. 7 days)
Serial data downloading:	9600 baud to a PC
Charger set-up:	held in non-volatile memory

```
        ;definitions

W       equ        H'0'
F       equ        H'1'

temp    equ        h'C'      ;temp reg
temp2equ           h'D'      ;temp reg

        ;PORTB
en      equ        h'4'      ;enable for display
cd      equ        h'5'      ;control/data to display

        ; set up display

        movlw      h'C3'     ; 8 bit+dis,ch set
        movwf      PORTB     ;put to PORTB
        bsf        PORTB,en ;enable
        bcf        PORTB,en ;disable

        clrf       temp2
        movlw      d'6'      ;delay for 4100us
        movwf      temp
st2     decfsz     temp2,F
        goto       st2
        decfsz     temp,F
        goto       st2

        movlw      h'C3'     ; 8 bit+dis,ch set
        movwf      PORTB     ;put to PORTB
        bsf        PORTB,en ;enable
        bcf        PORTB,en ;disable

        movlw      d'33'     ;delay for 100us
        movwf      temp
st3     decfsz     temp,F
        goto       st3

        movlw      h'C3'     ; 8 bit+dis,ch set
        movwf      PORTB     ;put to PORTB
        bsf        PORTB,en ;enable
        bcf        PORTB,en ;disable

        ; wait 120uS (use 13 for 40us)
        movlw      d'32'     ;w=32
        movwf      temp      ;temp=32
st4     decfsz     temp,1    ;dec skip zero
        goto st4

        movlw      h'C3'     ; 4 bit+dis,ch set
        movwf      PORTB     ;put to PORTB
        bsf        PORTB,en ;enable
        bcf        PORTB,en ;disable

        ; wait 120uS (use 13 for 40us)
        movlw      d'32'     ;w=32
        movwf      temp      ;temp=32
st5     decfsz     temp,1    ;dec skip zero
        goto st5

        movlw      h'28'
        call       COUT      ;2 lines
        movlw      h'06'
        call       COUT      ;entry mode cursor right
        movlw      h'0E'
        call       COUT      ;display on,cursor,no blink
        movlw      h'01'
        call       COUT      ;clear + address 0

        ; wait 1600uS
        clrf       temp2
        movlw      d'2'      ;delay for 1600us
        movwf      temp
st6     decfsz     temp2,F
        goto       st6       ;3 x256 =768
        decfsz     temp,F
        goto       st6
```

Listing 1 – Startup routine for 4-bit mode display.

multiplexing. The 4-data lines to the display spend most of their time doing nothing, and the display ignores them until directed to by the 'enable' line.

So these 4-data lines could be also be used in their spare time as inputs to read the panel buttons. A single multiplexed data line/button is shown in Figure 1. The resistor 'R' is chosen to be low enough that it will generate a 'low' input against the PORTB 'weak pull up' of 0.1mA (set in the software), and high enough not to exceed the output current rating (20mA) when the I/O line is used as a high output to the display while a button is pressed.

I had now got down to a tantalising 14 I/O lines with a need to get to 13. The last challenge was to get the charge and discharge current signals into a single input. Here I just wondered "if you can 'wire or' digital signals I wonder if you can do the same with analogue signals?". The answer is 'yes' (see the circuit description). So I was down to 13 I/O lines and could get on with the programming.

Panel Input

I was happy with my 'next' and 'Start/Stop' buttons but wanted to do something better than using 'up' and 'down' buttons to set the charge time and number of cells. I didn't like the concept of having to press a button up to eight times to get from one charge time to another.

The solution is to use a 'digital potentiometer'. When turned this gives two trains of on/off signals 90° out of phase. Train A leads train B when it is turned clockwise and follows when going anticlockwise. See Figure 2. There are various ways of reading this code. I used the logic that if A closes after both A and B are off (high) then this means 'up', and if B closes after both A and B are off then this means 'down'. One benefit of this is that two separate 'up' and 'down' buttons could be used, if desired, without requiring any change in code.

From a programming viewpoint, I read the four buttons (two buttons plus digital potentiometer) once every 10ms. This helps reduce the effects of contact bounce.

Data Recording

The main use of the EEPROM is to record the voltage and current information. However, I also thought it would be useful to store the number of cells, charge time and charge/cycle, so if the charger was being used to repeatedly charge the same type of battery, the unit would always power up to the previous settings.

```
     call       COUT        ;send w as control byte
;or
     call       DOUT        ;send w as data


     ; display output subroutines
     ; data in w

COUT bcf        PORTB,cd    ;RB5=0 (control)
     goto       out1
DOUT bsf        PORTB,cd    ;RB5=1 (data)
out1 movwf      temp        ;store w
     movlw      h'F0'
     andwf      PORTB,F     ;clear lower nibble
     swapf      temp,W
     andlw      h'0F'       ;w=upper nibble
     addwf      PORTB,F     ;put to PORTB
     bsf        PORTB,en    ;enable to display
     bcf        PORTB,en    ;disable
     movlw      h'F0'
     andwf      PORTB,F     ;clear lower nibble
     movf       temp,W
     andlw      h'0F'       ;w=lower nibble
     addwf      PORTB,F     ;put to PORTB
     bsf        PORTB,en    ;enable
     bcf        PORTB,en    ;disable
     ; wait 120uS (use 13 for 40us)
     movlw      d'32'       ;w=32
     movwf      temp        ;temp=32
out2 decfsz     temp,1      ;dec skip zero
     goto out2
     return
```

Listing 2 – Display Routines for 4-bit mode.

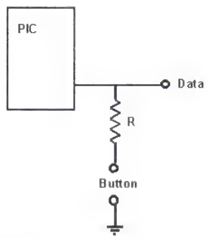


Figure 1.
Simple I/O Multiplexing.

In addition to recording the data, the unit also needs to know how many data points there are altogether. One option was to clear the data before each charge. A simpler solution (the one used) is to always record a '0' voltage into the next data slot. Hence, when downloading the data the program can just run until it sees a zero. I delayed the start of data recording by one minute, otherwise, pressing 'start' at the wrong time would record a useless data point and lose access to the previous set of data.

Assembly Code

A fair part of the code is what I now consider to be standard routines for driving the display, EEPROM, serial link and conversion subroutines (e.g. binary to decimal, binary to ASCII). Many of these have been covered here and in issue113 of *Electronics*. Code for driving the EEPROM will be covered next month. Soon after I put all these in I realised I was going to be pushed for space. I had created several 'screens' to collect the settings (number of cells, charge time, charge/cycle). This code was pretty thirsty on space as I was entering each character individually with two instructions (e.g. movlw 'x', call DOUT). I switched to using 'table read' which uses only one instruction per character once the overhead of the table calling routine has been invested. The Microchip application note AN556 gives a good explanation of how to do this. I made further savings by having a single input screen and moving the cursor to the data which has to be entered.

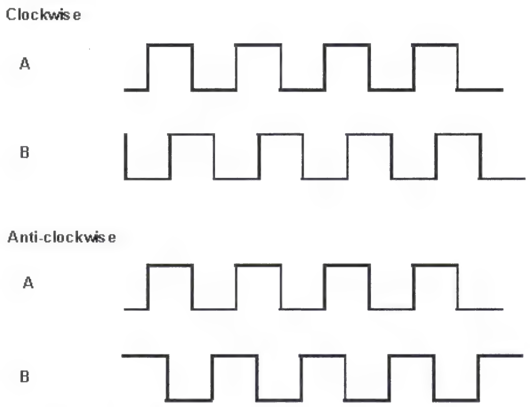


Figure 2. Digital Potentiometer.

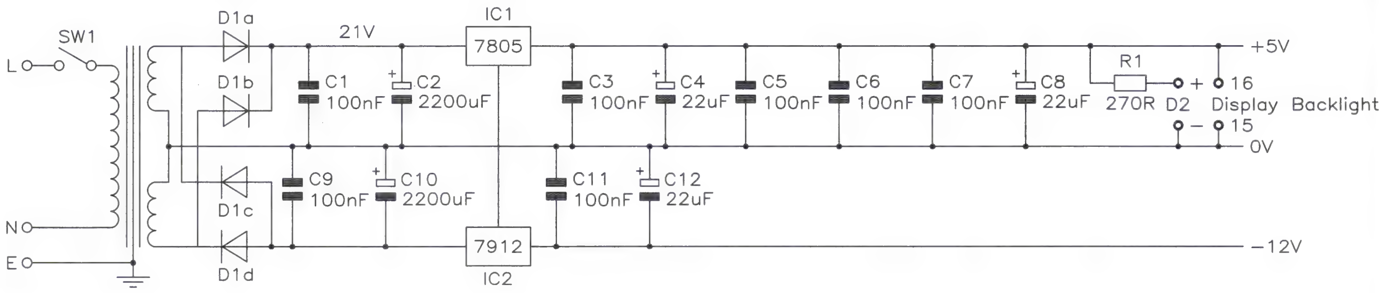


Figure 3a. Circuit diagram - power supply.

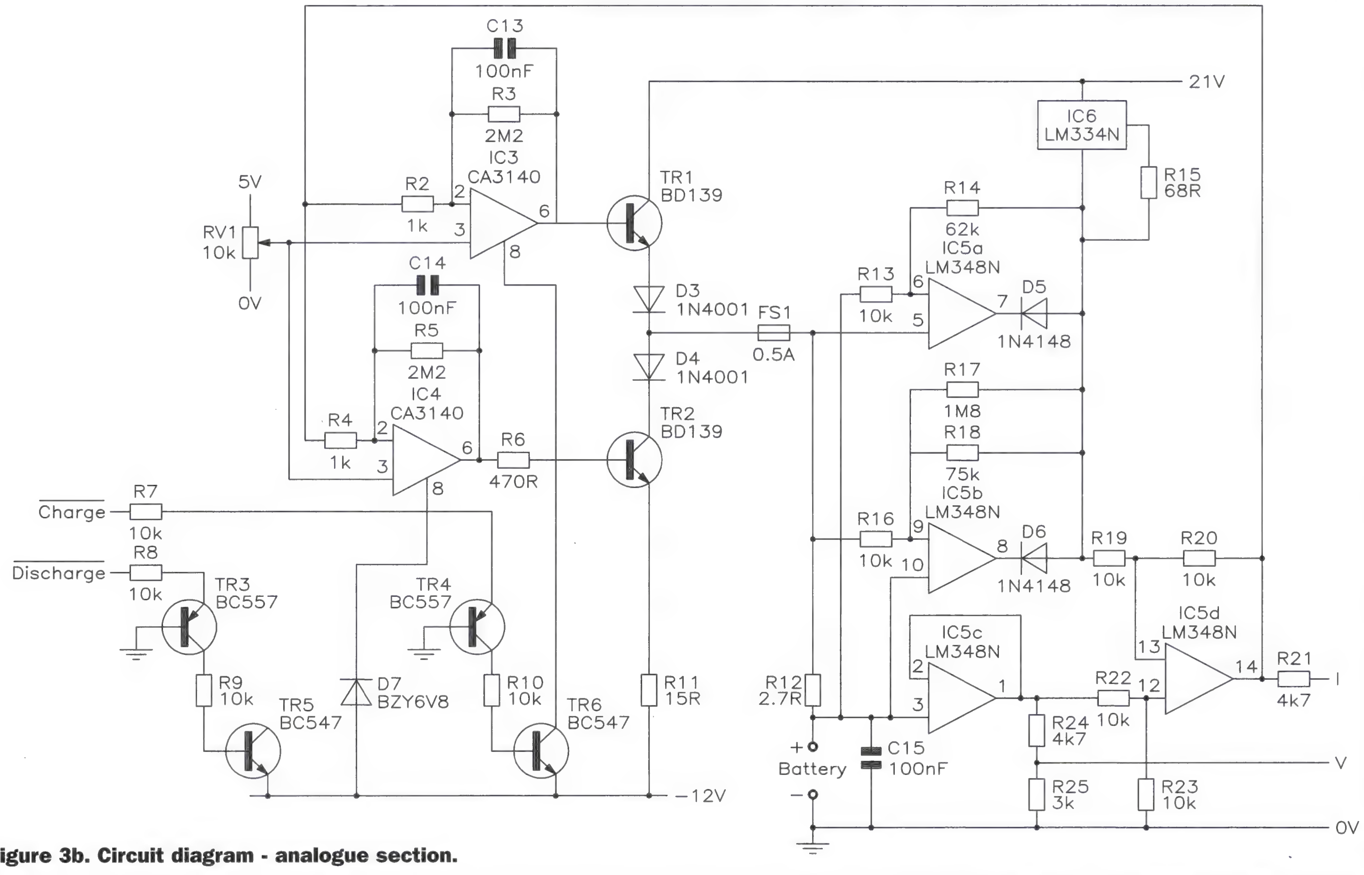


Figure 3b. Circuit diagram - analogue section.

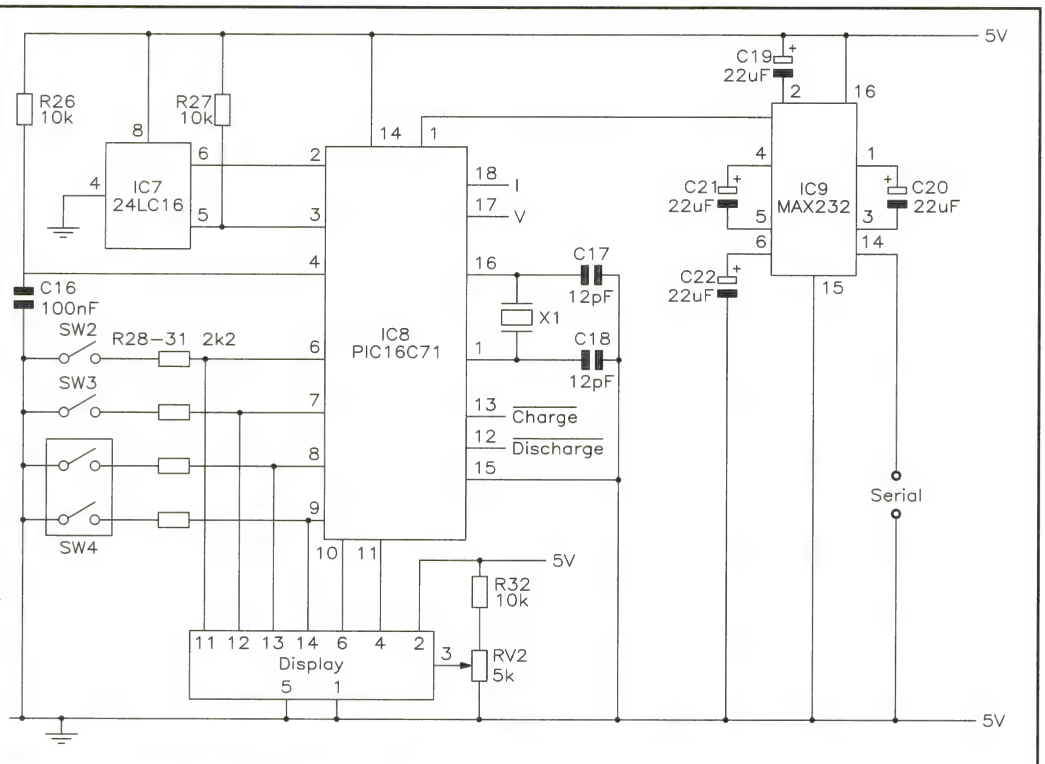


Figure 3c. Circuit diagram - digital section.

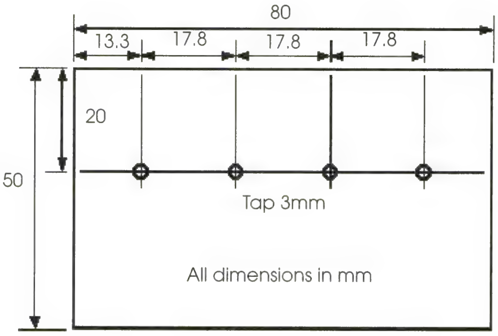


Figure 4. Heatsink drilling pattern.

This was not enough, so I then searched for sections of code that looked similar. I had separate routines for counting the charge and discharge hours, minutes and seconds. I combined these by introducing general second, minute and hour variables and copying these across as appropriate, depending on whether it was in charge or discharge mode. I also had separate routines for sending the voltage as ASCII characters to the display or down the serial link. Both of these used code to convert the voltage from a 0-255 binary number to ACSII text characters 0-12.75. This was put into a subroutine.

I was so close and yet so far! I needed 15 more instructions over the 1024 capability. I was determined not to sacrifice any of the functionality. The final breakthrough came from the collections of four 'nop' instructions used for short delays in the EEPROM driver routines. Maybe these should be in a subroutine. But wait; a subroutine call uses two instructions and so does the return. Hence this subroutine only needs a 'call' and a 'return' statement. So why not just place a call on an existing 'return' statement? In order to maintain the independence of these routines I simply replaced the four 'nop's with a call to the 'return' statement of each routine. This looks peculiar but is fine. The processor does not care were the 'return' statement is placed. The only potential concern is that this introduces an additional level of subroutine call, and one must not exceed the limits of the stack to record the program counters from each call (the PIC16C71 has 8-levels).

Software Overview

When I wrote my first (Z80) programmes I thought anyone who could fill more than 1000 lines of assembly code (about 15 pages of A4) must be insane. It is in fact quite easy to do this when one starts with a collection of standard routines. An analysis of this code gave the following breakdown:

	%
Start-up	8
Data input	37
Interrupt routine including time update, running display	20
Data conversion (binary to ASCII etc.)	15
EEPROM input/output	14
Serial transfer capability	6

Arguably, only the data input, interrupt routing and part of the serial transfer capability are special code. The rest (43%) are standard routines and can be 'cut and paste' from earlier projects.

Circuit Description

Analogue Section (Figure 3b)

The analogue section controls the discharge/charge as directed by the PIC to a current set by VR1, and converts the battery voltage and discharge/charge current to 0V to 5V signals which can be read by the PIC.

The key here is the 'wire or' of the charge and discharge currents to a single analogue signal equal to the larger of the two. Both the charge and discharge current amplifiers use the same 2.7Ω sensing resistor R12. With a gain of 6.2 a current of 256mA gives 5V, which is the full scale analogue input and held as 256 in binary, hence requiring no scaling in the PIC. (Full scale is actually 255 corresponding to 4.98V to 5.00V). The current sensing resistor is in the positive supply so the battery negative can be at earth potential. The 'current' is amplified by two of the operation amplifiers in IC5 to give negative going voltages with respect to the battery positive, representing the discharge/charge currents.

During discharge the 'charge' current gives a positive signal as does the 'discharge' signal during charge. The diodes D5 and D6 ignore the positive signals and select the most negative output, taking current from the constant current generator IC6. This is then inverted and turned into a positive signal relative to 0V by IC5d.

The current is controlled by TR1,2 which are driven by IC3,4. These latter ICs have the useful feature of having a 'strobe' input. This can be used to clamp or restrict the output voltage, and if both are clamped to the -12V rail the battery will be neither charged nor discharged. By releasing the clamp (turning TR 3,5 or TR 4,6 off) the battery can be charged or discharged. The current is set by potentiometer VR1. The amplifiers drive the measured current to this value. Zener diode D7 is included to limit the current in the event that both the charge and discharge amplifiers are turned on at the same time (this may happen during power-up).

Digital Section (Figure 3c)

The EEPROM is connected to PORTA. PORTA pin 4 is an open collector output which is ideal for the data line. This avoids conflict if both the PIC and the EEPROM try to send data at the same time.

The serial data link uses a standard MAX232 converter. Note that capacitors C19 to C22 are the right way round, and connect to the ±10V rails which are generated internally for the serial transmission.

Since the display is operated in 4-bit mode there are no connections to pins 7 to10 inclusive. VR2 adjusts the display contrast/viewing angle.

Construction

I usually install components in height order. So start with the three wire links, resistors, IC socket (for the PIC), capacitors

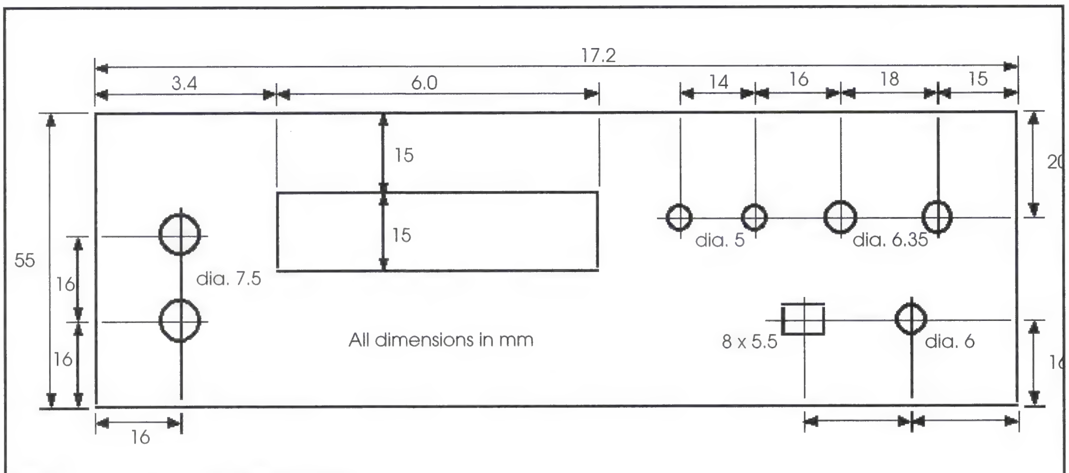


Figure 5. Front panel dimensions.

etc. Leave the voltage regulators IC1,2 and TR1,2 until last. When everything else is in place fit the voltage regulators, pushed as close as they can down onto the PCB. Bend at least one lead of each under the board to strengthen the connection as these support this end of the PCB. Then 'Z' bend the leads so that their bodies can go flat onto the heatsink. Drill and tap (3mm) the heat sink (see Figure 4), then use the heatsink as a template to accurately solder TR1,2 in place. If you do not want to tap these holes then it should be possible to fit nuts to longer bolts. The holes are aligned with gaps in the fins.

Drill the front and rear panels as in Figures 5,6. The PCB is held at one end using 14mm spacers from the base. Mount the spacers on the PCB and assemble to mark the locations for the holes in the base. The transformer bolts onto the base. There should be 5mm space all round.

I fitted the display using M2.5 counter sunk head bolts adjusted to be flush with the face of the display, and glued these in place with a glue gun (take care not to get glue on the display face). One benefit of this method is that minor adjustments of the position can

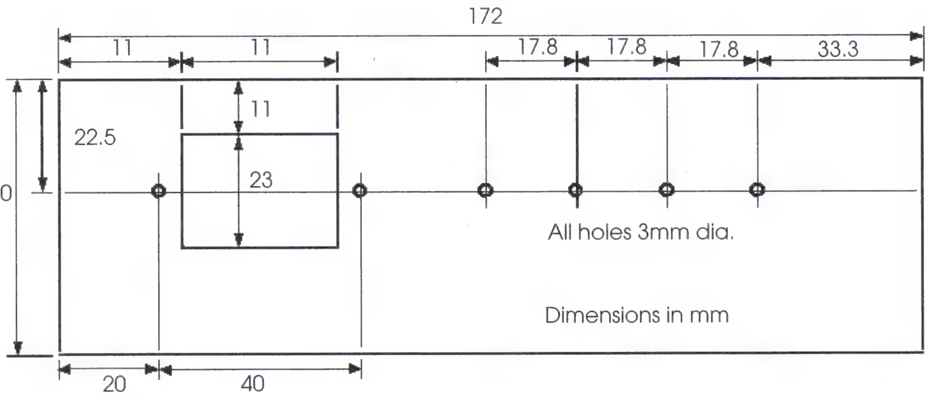


Figure 6. Rear panel dimensions.

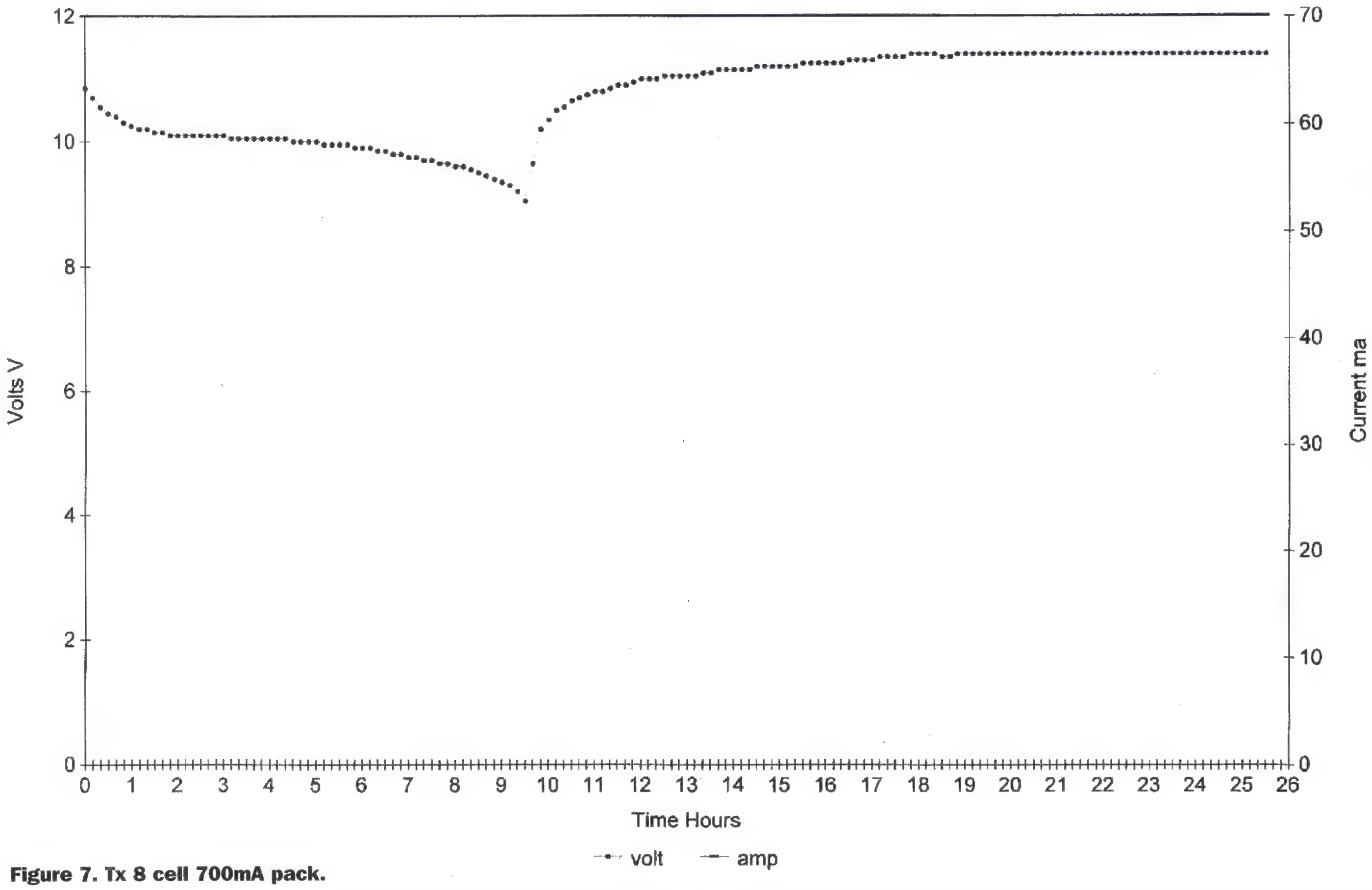


Figure 7. Tx 8 cell 700mA pack.

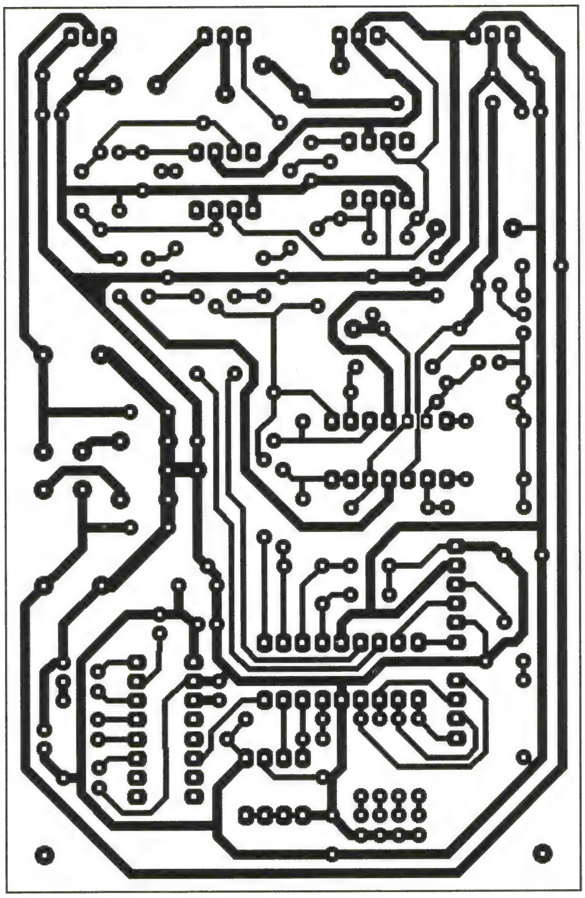


Figure 8. PCB Foil.

be made afterwards by applying a soldering iron to the back of the bolt heads – remelting the glue. Alternately longer bolts could be used through the panel.

Lastly connect the display and panel potentiometers, buttons and LED (D2). The new displays in the Maplin catalogue include backlit versions incorporating a current limiting resistor for 5V operation via connections 15,16. Run an earth connection from the mains chassis plug to the enclosure base and to the PCB earth connection point.

The serial lead is made up with a normal audio coax connection to the 3.5mm mono plug with the other end configured as follows:

	9pin D	25pin D
ground / '-'	5	7
data/signal	2	3
connect DTR, DSR	4,6	20,6
connect RTS, CTD	7,8	4,5

Note that all the 'connect' links need to be in place. Some 25/9-way adapters do not include a full set of internal links – hence it is better to go direct to the appropriate 'D' connector.

Operation

On power up the display should show:

```
Charge
8Cells 16hr
```

Turning the 'up/down' digital potentiometer changes 'Charge' to 'Cycle'. Press 'Next' to move the cursor under the '8'. Adjust as necessary using the 'up/down' pot. Press 'Next' again to adjust the charge time. At any time during the above pressing 'st/st' (start/stop) starts the cycle/charge. Alternatively if you wish to adjust the data again press 'Next' again (to show 'Download?') and then a second time to get back to the beginning.

During the cycle/charge the display will show (for example):

```
8C      10.65V   C 0:00
16h     50ma     D 0:00
```

The ':' of the appropriate time ('C' = charge, 'D' = discharge) will pulse once per second to show if it is charging or discharging. A first idea of the state of the battery can be seen from the discharge time. When the cycle/charge has finished or has to be terminated early press 'st/st'. The display will show 'Download?'. Press 'st/st' again to download the data via the serial link, or 'Next' to get straight back to the beginning. At the end of downloading the display will show 'Done' for a couple of seconds before reverting to the beginning.

To receive the data a PC serial port should be set up (e.g. via Windows Terminal.exe) to:

Baud	9600
Data bits	8
Parity	None
Flow Control	None

Also in Settings/Terminal Preferences set CR > CR/LF for inbound. The data is loaded (using 'Receive Text File') into a *.txt file. The format of the data is: 'voltage', tab, 'current', CR, repeating. This can then be 'cut and paste' into a spreadsheet (or with some spreadsheets can be opened direct) for plotting/analysis. Figure 7 gives an example plot for a 700mAhr 8 cell transmitter battery pack.

The author can supply a simple piece of software (OK for DOS/Windows) to receive the data if required.

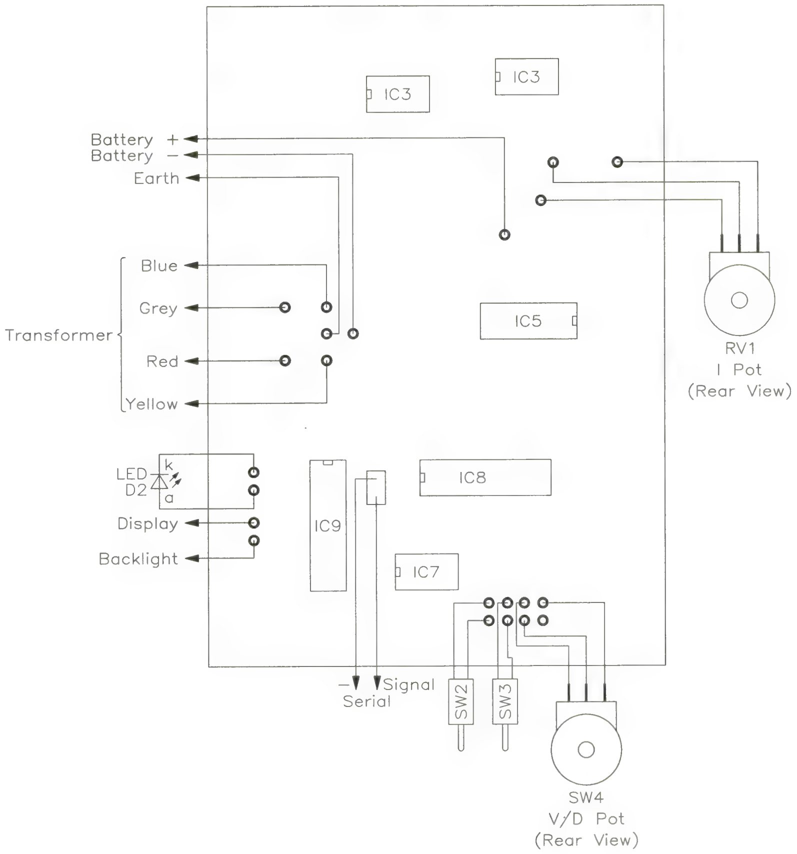


Figure 9. Connections to off-board components.

PROJECT PARTS LIST

RESISTORS		
R1	Min Res 270Ω	M270
R2,4	Min Res 1k	M1k0
R3,5	Min Res 2M2	M2M2
R6	Min Res 470Ω	M470R
R7,8,9,10,13,16, 19,20,22,23,26, 27,32	Min Res 10k	M10K
R11	W/W 3W 15Ω	W15R
R12	Min Res 2.7Ω	M2R7
R14	Min Res 62k	M62K
R15	Min Res 68Ω	M68R
R17	Min Res 1M8	M1M8
R18	Min Res 75k	M75K
R21,24	Min Res 4k7	M4K7
R25	Min Res 3k	M3K0
R28,29,30,31	Min Res 2k2	M2K2
VR1	10k Pot	*
VR2	Cermet 5K	WR41U
CAPACITORS		
C1,3,5,6,7,9,11,13, 14,15,16	Poly Film 0.1μF 63V	DT98G
C2,10	Gen Elect 2200μF 35V	AT64U
C4,8,12,19,20,21,22	Gen Elect 22μF 35V	AT56L
C17,18	Ceramic 12pF	WX45Y
SEMICONDUCTORS		
D1	Bridge Rect WO2	AQ96E
D2	LED red	QW86E
D3,4	Diode 1N4001	QL73Q
D5,6	Diode 1N4148	QL80B
D7	Zener BZY88C 6V8	QH10L
IC1	Reg 7805	AV16S
IC2	Reg 7912	AV20W
IC3,4	CA3140E	QH29G
IC5	LM348N	AV43W
IC6	LM334N	WQ32K
IC7	24LC16B/P	AD23A
IC8	Pre-programmed PIC	*
IC9	MAX232	FD92A
TR1,2	BD139	QF07H
TR3,4	BC557	QQ16S
TR5,6	BC547	QQ14Q

MISCELLANEOUS			
Trans	Transformer 0-15V x 2 15VA		DH57M
X1	3.2768MHz crystal		FY86T
Display	16 x 2 Display		NT57M
	IC socket		FJ66W
	Heat sink		HQ70M
	TO126 insulator		WR26D
	TO220 insulator		WR23A
	LED clip	1	YH62S
	Enclosure	1	XJ27E
	3mm knobs	2	JZ86T
	3.5mm plug	1	HF80B
	3.5mm socket	1	CX93B
	2.5MM plug	1	HH62S
	2.5mm socket	1	JK10L
	9/25 way D socket	1	RK61R/YQ49D
	9/25 way hood	1	FP27E/FP29G
	Mains inlet	1	HL15R
	Insulation cover for above	1	JK66W
	Mains lead	1	MK41U
	Ribbon cable	1	XR06G
	Earth wire	1	XR38R
	Coax	2	XR16S
SW1	Sub Min Toggle	1	FH00A
SW2	Sub Min Push black	1	JM01B
SW3	Sub Min Push red	1	JM47B
SW4	Digital potentiometer	1	*
	PCB	1	*
	M2.5 12mm CS bolts	1	BF40T
	M3 10mm PH bolts	1	JY22Y
	M2.5 nuts	1	JD61R
	M3 nuts	1	JD62S
	M3 treaded spacers	1	FG38R

A set of non-Maplin parts (indicated by * e.g. PCB, Programmed PIC, digital potentiometer and matching miniature potentiometer (VR2)) are available from the author for £25 including postage. A disc with software for receiving the data into a text file (plus the assembly code Listings 1 and 2 here and the assembly code from Putting PICs to work article from Electronics issue 113) is available from the author for £5 including postage.

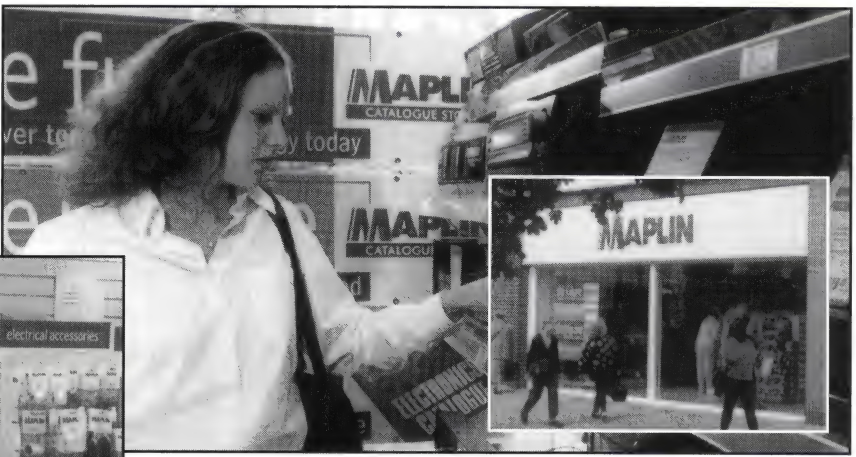
Dr M P Roberts, 4 Thames Avenue, Guisborough, Cleveland, TS14 8AD.

VISIT A MAPLIN STORE FOR ELECTRONICS AND MORE

NEW STORE AT CHELTENHAM

THERE'S A WHOLE WORLD OF ELECTRONICS TO EXPLORE AT YOUR MAPLIN CATALOGUE STORE

TELEPHONE CUSTOMER SERVICES ON (01702) 554002 FOR DETAILS OF YOUR NEAREST MAPLIN STORE



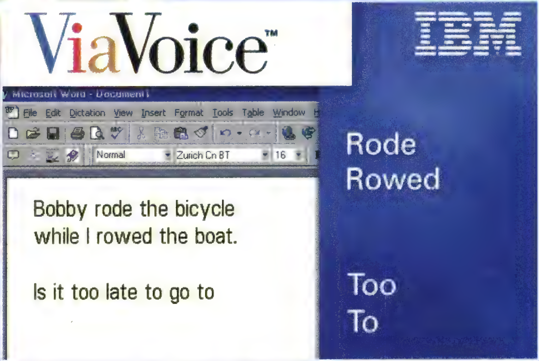
MAPLIN ELECTRONICS

BARNSLEY BELFAST BIRMINGHAM BRADFORD BRIGHTON BRISTOL CARDIFF CHATHAM CHEETHAM HILL CHELTENHAM COVENTRY DONCASTER DUDLEY EDGWARE EDINBURGH FOREST HILL GLASGOW GRIMSBY HAMMERSMITH ILFORD LEEDS LEICESTER LUTON LIVERPOOL MAIDSTONE MANCHESTER (Oxford Road) MARBLE ARCH MIDDLESBROUGH MILTON KEYNES NEWCASTLE-UPON-TYNE NORTHAMPTON NOTTINGHAM NORWICH PORTSMOUTH PRESTON READING SHEFFIELD SLOUGH SOUTHAMPTON SOUTHEND-ON-SEA STEVENAGE STOCKPORT STOKE-ON-TRENT THURROCK (Lakeside) WATFORD WOOD GREEN

Conversing WITH COMPUTERS

Everyone is talking about speech recognition applications, but how well do these packages really listen? In this review feature, Stephen Waddington takes a look at the first generation of software that could make the keyboard a thing of the past.

Photo 1. ViaVoice is bundled with an Andrea NC-8 noise-cancelling microphone headset.


ViaVoice™
IBM
Microsoft Word - Document1
File Edit Dictation View Insert Format Tools Table Window
Normal
Zurich Cn BT
16

Bobby rode the bicycle while I rowed the boat.

Is it too late to go to

Rode
Rowed

Too
To

Photo 2. ViaVoice has the ability to integrate with numerous applications including Microsoft Word.

Remember HAL-9000, the fictional computer in 2001: A Space Odyssey? Although the latest clutch of first generation continuous-speech recognition is a major step forward, we are still a few years behind HAL's natural-language capabilities.

Speech recognition itself is nothing new. Dictation systems for specific professions such as radiology have been around for years. Often, these systems carried five-figure price tags and required expensive workstations. Less expensive, general-purpose systems required discrete speech, a tedious method of dictation in which you pause after each word.

Continuous-Speech Voice Application

Until now, most speech-recognition programs for the PC have not been worth talking about. Figure 1 plots the course of voice-recognition history. Early applications needed the user to pause between each word during dictation and to correct a significant number of errors. Recently, however, two new applications were launched on the market that can recognise normal speech patterns and deliver more accurate results.

IBM's ViaVoice and Dragon Systems' Dragon Dictate Solo can take dictation with less effort on the speaker's part. We decided to test these two products head-to-head, since they are both first generation products for the Windows platform.

Both ViaVoice and Dragon Dictate Solo are intended as continuous-speech applications and are designed for dictation tasks but give only limited control over your PC. Another class of emerging speech recognition products, known as command-and-control applications, allows you to operate your computer with spoken commands.

Hardware Requirements

A major factor driving the development of these speech recognition applications is the steady march of computing power. Speech recognition systems demand a lot of processing power and disk space. ViaVoice was tested on a number of different computers including a 166MHz Pentium laptop, a 166MHz Pentium MMX desktop and a 300MHz Pentium II desktop. IBM recommends a minimum of a 166MHz Pentium with 32Mbytes of RAM with Windows 95 and 48Mbytes of RAM with Windows NT Workstation. At least 125Mbytes of available hard-disk space is also needed.

Speech recognition products require a high hardware specification because they have a complex job to do. Both ViaVoice and Dragon Dictate Solo use a microphone connected via the soundcard for input. The words you speak are captured by microphone and processed digitally by the sound card.

How it Works

The first component of the engine, the acoustic processor, filters out background noise and converts the captured audio into a series of sounds that correspond to the phonemes-units of speech making up the selected language, such as English. Both the IBM ViaVoice and Dragon Dictate Solo applications are speaker-independent and contain a default set of phonemes. Users are required to train the system, creating a personalised set of phonemes for improved accuracy.

The voice recognition software then analyses the sound to distinguish between the lower-frequency vowel sounds and the higher-frequency sounds used for consonants. The results are then compared with phonemes, groups of phonemes, and words to come up with the most likely matches.

These pattern-matching algorithms must not only be accurate and fast, they must also be flexible to account for variations including tone, pitch, inflection, and rate. In a final effort to yield the most accurate results, speech recognition systems look at contextual information to predict what words should come next.

Set-up Procedure

ViaVoice priced £99.99 offers intuitive set-up and training procedures. It is a very user-friendly piece of software. After loading up the application from CD-ROM, a 'Microphone Set-up Wizard' checked ambient background noise and typical speech levels. The next step was a 265-line enrolment session, which concluded with a reading from Mark Twain's 'A Ghost Story.'

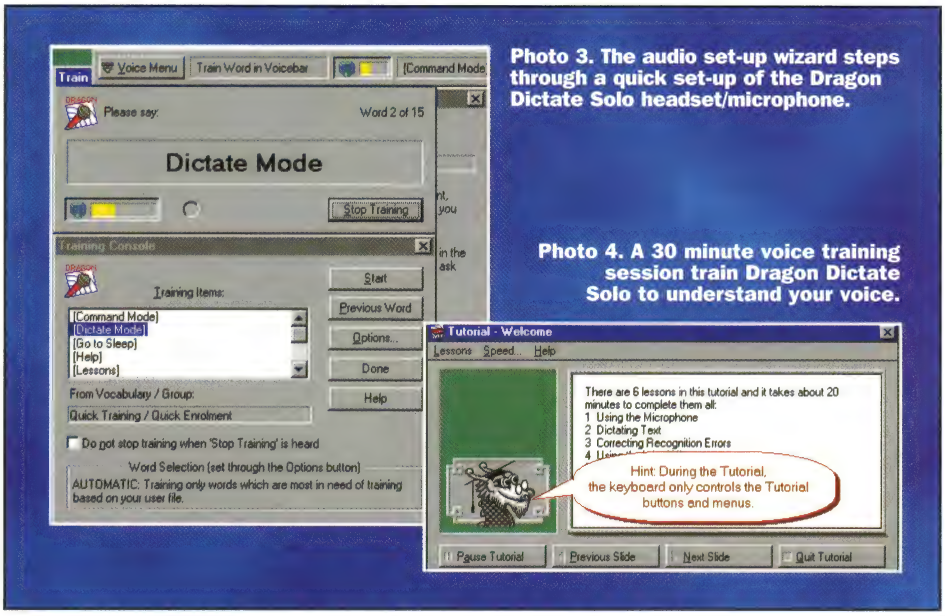
If recognition problems occur, the program will prompt you to repeat the passage. This process is tiresome, since the user spends anywhere from 30 minutes to an hour dictating to the computer, but is necessary to enable the computer to distinguish an individual's accent and voice patterns.

ViaVoice is bundled with an Andrea NC-8 noise-cancelling headset/microphone as shown in Photo 1. The headset is comfortable, but the microphone arm was too flexible and required frequent adjustments to keep it away from the speaker's face. With the help of on-screen prompts, you can easily adjust the audio volume of the microphone and headset.

Speech Timeline

1950	Speech recognition research begins
1964	IBM demonstrates Shoebox for spoken digits at New York World's Fair
1968	The HAL-9000 computer in 2001: A Space Odyssey introduces the world to speech recognition
1978	Texas Instruments introduces the first single-chip speech synthesiser and the Speak and Spell toy
1993	IBM launches the first packaged speech recognition product, the IBM Personal Dictation System for OS/2
1993	Apple ships PlainTalk, a series of speech recognition and speech synthesis extensions for the Macintosh
1994	Dragon Systems' Dragon Dictate for Windows 1.0 is the first software PC-based dictation application
June 1997	Dragon ships Naturally Speaking, the first general-purpose continuous-speech recognition product
August 1997	IBM ships ViaVoice

Figure 1. Voice recognition timeline.



☐ Do not stop training when 'Stop Training' is heard

Word Selection (set through the Options button)
AUTOMATIC: Training only words which are most in need of training based on your user file.

There are 6 lessons in this tutorial and it takes about 20 minutes to complete them all:
1 Using the Microphone
2 Dictating Text
3 Correcting Recognition Errors

Hint: During the Tutorial, the keyboard only controls the Tutorial buttons and menus.

Photo 3. The audio set-up wizard steps through a quick set-up of the Dragon Dictate Solo headset/microphone.

Photo 4. A 30 minute voice training session train Dragon Dictate Solo to understand your voice.

Speak to me

ViaVoice can be configured for more than one user – so if you share a PC with members of your family or a colleague at work, you can define your own configuration. Once the set-up or enrolment procedure is complete, you're ready to start dictating.

There are numerous ways to work with ViaVoice and manipulate text. The application includes its own word processor SpeakPad, but also integrates with Microsoft Word as shown in Photo 2, and includes a method for transferring text to any Windows application.

As can be expected with any processor-intensive software, the more powerful the machine, the more ViaVoice takes advantage of it. A speedier processor means that text appears on screen faster and more fluidly. Audio playback enables the user to select a word or block of text and hear the original recording, so providing a convenient aid to correction.

Achieving productive results is difficult at first. However, the good news is that the products will improve over time, so its worth persevering. It seems best to make corrections after the dictation session, since ViaVoice lacks real-time correction. With dictation stopped, you can double-click on the incorrect word or phrase and select the appropriate correction from a pop-up list of alternatives.

Unlike an optical character recognition (OCR) application, which may produce misspelled words, a speech recognition application will always yield actual words, even if they're not the ones you intended, so a spell-checker is no help during the correcting process.

Vital Statistics

IBM reckons that users can enter text at up to 140 words a minute. After using the product for two hours, my personal best was up to 48 words per minute with an accuracy rate of 86%. I've obviously some way to go.

Out of the box, ViaVoice includes an active vocabulary of 30,000 words that can be expanded to 64,000 words. Its vocabulary-expander utility analyses your existing text or Microsoft Word documents to automatically expand the active vocabulary with frequently used unique words such as your name or company name.

Also included is a text-to-speech synthesiser, which lets you adjust the tone and pitch of the voice that reads your words, and displays an 'actor' on the screen as well, whose lips move as the words are being read.

Limitations

Under test ViaVoice scored an average accuracy of 78% after an hour of training, and 86% after a second hour of practise. This should be levelled against the fact that ViaVoice becomes more accurate with increased use especially if you correct errors immediately after they occur.

After the accuracy issues, the main limitations of the software application are the editing features and the formatting options. ViaVoice's correction feature presents a list of possible alternative words and lets you type the correct spelling. This process is completely keyboard driven. The actual formatting commands provided in ViaVoice are limited to 'New-Paragraph,' 'New-Line,' and some basic capitalisation command.

The last issue is addressed by IBM in ViaVoice Gold priced £139, released in February this year which includes command-and-control capabilities as well as desktop navigation and direct dictation into any application. The new command and control features let you open, close, and switch between programs by name.

Within applications, you can activate and choose menu items, move the cursor, cut and paste text, and perform many keyboard actions. ViaVoice Gold's installation can put a Dictation item on the Microsoft Word menu bar, so you can dictate directly into Word. A dictation transfer utility lets you move already recognised text into Windows applications, but the Gold version enables direct dictation into most Windows 95 or NT programs.

Virgin Dictation

This section of the article is a complete first for me. The entire article from here on has been written – or should I say more accurately dictated – using Dragon Systems' Dragon Dictate Solo and verbally corrected as and when required.

Dragon Systems was one of the first voice recognition applications to be launched for the PC in 1994. Forget paper. This software promises to make the prospect of talking information into a computer a fast and reliable option. The product includes a 30,000-word dictionary and a 30,000 word backup dictionary to which you can add additional words. The software requires a minimum of a 486, 66MHz processor although a Pentium 166MHz is recommended, together with 16Mbytes of memory, 36Mbytes of hard-disk space and a 16-bit sound card. Most sound cards are supported, but check with Dragon Systems for the current list of approved sound cards.

Installation and Set up

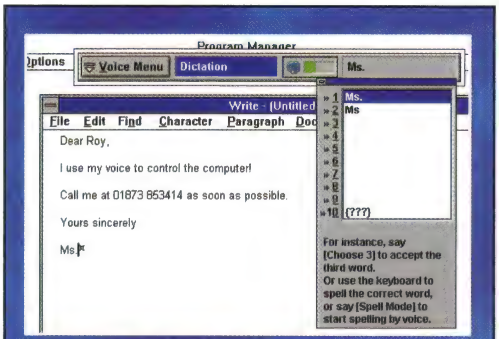
After the software was installed, the Audio Set-up Wizard – appropriately an on-screen dragon – steps through a quick set-up of the bundled VXI headset/microphone to verify that it is communicating correctly with the system's audio hardware as shown in Photo 3. This process allows a user to adjust the volume of the speaker, which, in turn, allows you to gauge the quality of the microphone and the input levels. Like ViaVoice, Dragon Dictate Solo can be configured for more than one user.

Once the Wizard has completed running, a 30 minute process of initial voice training takes over as shown in Photo 4. If the program either does not understand what was said or for its own artificial intelligence reasons would like to hear it again, it may ask the user to repeat words, phrases or entire sentences during the initial training. In older technologies, the computer trained the user to speak properly. Here, it is the user who trains the computer to hear properly.

Once completed, Dragon Dictate Solo modifies its voice-recognition database and after a short set-up time, users can really 'talk' to their machines and be heard. Even after an abbreviated training session, Naturally Speaking was about 85% accurate, with an accurate dictation speed of approximately 20 words per minute. After a further two hours of dictation with continual correction, accuracy jumped to more than 92%, with a reading speed of 38 words per minute.

When you dictate, Dragon Dictate Solo will inevitably make recognition errors. You should always correct errors while you are dictating, because the application learns as much from words it recognises correctly as those it recognises incorrectly. For instance, if you say "park", but Dragon Dictate Solo recognises it as "dark", if you don't correct the error, the next time you say "park", the application is even more likely to recognise it as "dark".

It is possible to correct recognition errors as soon as they happen with the Choice List as shown in Photo 5. This appears whenever the application comes across a word that it



Dear Roy,

I use my voice to control the computer!

Call me at 01873 853414 as soon as possible.

Yours sincerely

Ms.

For instance, say [Choose 3] to accept the third word.
Or use the keyboard to spell the correct word, or say [Spell Mode] to start spelling by voice.

Photo 5. The Choice List allows the user the select the required word should Dragon Dictate Solo misunderstand any dialogue.

System Requirements	IBM ViaVoice	Dragon Dictate Solo
Hardware requirements	166MHz Pentium processor with 32Mbytes of RAM	486, 66MHz processor although a Pentium 166MHz
Operating System	Windows 95 Windows NT	Windows 3.1 Windows 95 Windows NT
Hard disk space	125Mbytes	36Mbytes
Features		
Active Vocabulary	30,000	30,000
Total number of words in customisable dictionary	30,000	34,000
Total number of words in vocabulary	60,000	64,000
Performance		
Reading speed after 2 hours usage	48 words per minute	38 words per minute
Accuracy after 2 hours usage	86%	92%
Additional Features		
Microphone on/off feature	No	Yes
Text read back option	Yes	No
Cost		
Price and availability	£99.99 available from computer high street retailers	£49.99 available from Maplin Electronics (Order code KV42V)

Figure 2. Head to head specification and performance analysis of ViaVoice and Dragon Dictate Solo.

is unable to interrupt accurately. The Choice List can also be opened by the user, by saying "oops" to indicate that you have made an error. The Choice Lists displays the words that Dragon Dictate Solo thinks you said, starting with the most likely. When a comma is required you say 'comma' and likewise with a 'full stop'.

Head to Head

Given that Dragon Dictate Solo is a product supplied by Maplin (Order Code KV42V) and ViaVoice from IBM is not, it would have been very easy to dismiss the latter product. Allow me to resist all temptation – let me give you the facts, and you can decide for yourself. This is after all intended to be an independent review.

Dragon Dictate Solo is priced at £49.99, which is approximately half the cost of the IBM ViaVoice application. While you usually pay what you get for, it doesn't seem to be the case in this instance. Figure 2 profiles the performance of each application. Clearly Dragon Dictate Solo appears to be the superior option, particularly when price is considered.

The Dragon Systems product simply seems to have been better thought out than IBM's alternative. For example, Dragon Dictate Solo offers the option of switching the microphone off – you simply say "go to sleep". This means you can make a phone call or speak to another person in the room. ViaVoice offers no such option – or at least if it does I failed to find it, which meant that at one point I had to delete half a telephone conversation from my screen.

To switch the microphone back on, you say "wake up" from within the Dragon Dictate Solo application. You would have thought at the very least, IBM could have put a switch in the lead of the microphone to allow it to be switched off.

So what is the downside? While Dragon Dictate Solo does have the advantage of a limited command-and-control feature set over its IBM counterpart, it is limited to basic functions such as open-window and close-window. In addition, it is only possible to dictate to a handful of supported applications.

DragonDictate
for Windows
Solo
Dictate to your PC and control your Windows applications
Voice alone
from ENDEAVOUR TECHNOLOGIES

Dragon Dictate Solo £49.99 order code KV42V.

ViaVoice Gold improves on this functionality, offering dictation integration with any application and complete command-and-control capability for the Windows 95 environment. But Dragon Systems' has also recently launched a second generation of its Dictate Solo application in the form of Naturally Speaking.

Final Word

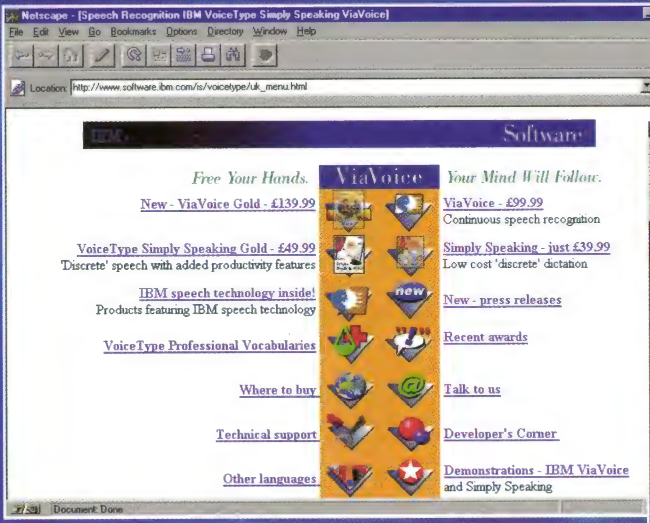
So does voice recognition work? I think it is fair to say it does, given the fact that I have dictated the last 800 words of this article. That said, there is still some way to go. PC voice dictation systems will need to reach an accuracy rate in the high 90s before consumers accept them for day-to-day usage. And despite the fact that IBM claims ViaVoice can handle 140 words per minute, and Dragon Systems' reckons Dictate Solo can cope with regular spoken language, the reality does not quite match up to the marketing hype.

If you're technology literal, you'll probably be happy to use first generation applications and are likely to find the errors entertaining. If you hate technology try the second generation products, you'll need a recognition level approaching 100%, otherwise you will just get annoyed at constantly having to correct your PC.

Further Reading

For further information on IBM ViaVoice check: **`www.software.ibm.com/is/voicetype/uk_menu.html`**. (Photo 6).

For further information on Dragon System's Speak Easy, check: **`www.dragonsys.com`**. (Photo 7).


Netscape - [Speech Recognition IBM VoiceType Simply Speaking ViaVoice]
File Edit View Go Bookmarks Options Directory Window Help
Location: http://www.software.ibm.com/is/voicetype/uk_menu.html
IBM
Software
ViaVoice
new
Document: Done

Free Your Hands. Your Mind Will Follow.

New - ViaVoice Gold - £139.99

ViaVoice - £99.99
Continuous speech recognition

VoiceType Simply Speaking Gold - £49.99
'Discrete' speech with added productivity features

Simply Speaking - just £39.99
Low cost 'discrete' dictation

IBM speech technology inside!
Products featuring IBM speech technology

New - press releases

VoiceType Professional Vocabularies

Recent awards

Where to buy

Talk to us

Technical support

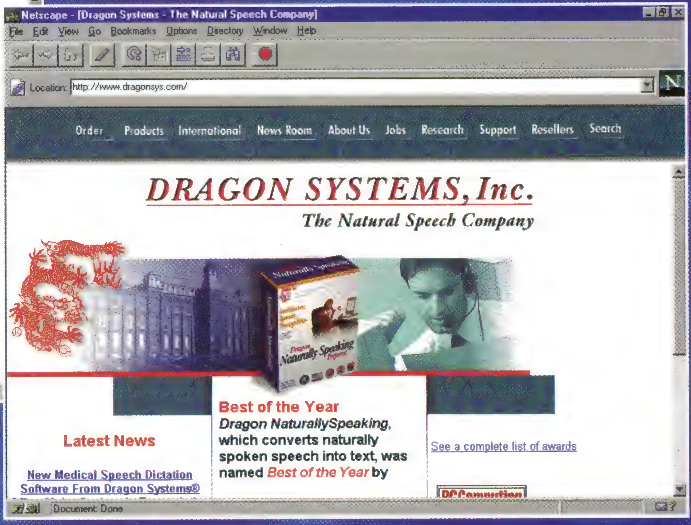
Developer's Corner

Other languages

Demonstrations - IBM ViaVoice and Simply Speaking

Photo 6. IBM ViaVoice Web site.

Photo 7. Dragon Systems Web site.


Netscape - [Dragon Systems - The Natural Speech Company]
File Edit View Go Bookmarks Options Directory Window Help
Location: http://www.dragonsys.com/
Order
Products
International
News Room
About Us
Jobs
Research
Support
Resellers
Search
Dragon NaturallySpeaking
Document: Done

DRAGON SYSTEMS, Inc.
The Natural Speech Company

Latest News

New Medical Speech Dictation Software From Dragon Systems®

Best of the Year
Dragon NaturallySpeaking, which converts naturally spoken speech into text, was named *Best of the Year* by

See a complete list of awards

Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

June 1998

1 to 2 June. Electronics: The Next 30 Years, Warwick. Tel: (0171) 287 4898.

1 to 2 June. Practical Industrial Process Measurement for Engineers, Glasgow. Tel: (0181) 335 4014.

1 to 2 June. Practical Power Systems Protection For Engineers, London. Tel: (0181) 335 4014.

2 to 4 June. Environmental Technology Exhibition, Birmingham. Tel: (0181) 910 7910.

3 to 4 June. Electronics Forum Exhibition, Manchester. Tel: (01799) 528292.

3 to 4 June. Instrumentation South West 98 Exhibition, Bristol. Tel: (01822) 614671.

4 to 5 June. Online Help Conference Europe 98, Olympia, London. Tel: (01844) 214690.

4 to 5 June. Practical Power Systems Protection For Engineers, Southampton. Tel: (0181) 335 4014.

8 to 9 June. Practical Power Systems Protection For Engineers, Bath. Tel: (0181) 335 4014.

10 to 11 June. VAC & SEMI 98 Exhibition, Scotland. Tel: (01822) 614671.

11 to 12 June. Practical Power Systems Protection For Engineers, Birmingham. Tel: (0181) 335 4014.

15 to 16 June. Practical Power Systems Protection For Engineers, Manchester. Tel: (0181) 335 4014.

16 to 17 June. European Conference on Vehicle Electronic Systems, Coventry. Tel: (01372) 367000.

17 to 18 June. Government Computing Show, The Royal Horticultural Hall, London. Tel: (0171) 587 1551.

17 to 18 June. Business Intelligence, Olympia, London. Tel: (0181) 879 3300.

18 to 19 June. Practical Power Systems Protection For Engineers, Leeds. Tel: (0181) 335 4014.

22 to 23 June. Practical Power Systems Protection For Engineers, Newcastle. Tel: (0181) 335 4014.

23 to 25 June. Networks Telecom Exhibition and Conference, Birmingham. Tel: (0181) 742 2828.

25 to 26 June. Practical Power Systems Protection For Engineers, Glasgow. Tel: (0181) 335 4014.

August 1998

23 to 28 Aug. European Conference on Artificial Intelligence, University of Sussex and University of Brighton, the Brighton Conference Centre, Brighton. Tel: (01273) 678 448.

September 1998

1 to 4 Sept. Control 1998, University of Wales Swansea. Tel: (0171) 240 1871.

9 to 11 Sept. Sixth UK Mechatronics Forum International Conference, Hotel Billingehus Conference Centre, Skovde, Sweden. Tel: (0171) 240 1871.

11 to 15 Sept. International Broadcasting Convention, Amsterdam. Tel: (0171) 240 1871.

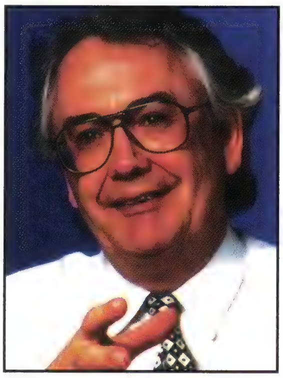
21 to 23 Sept. Power Electronics & Variable Speed Drives, IEE, Savoy Place, London. Tel: (0171) 240 1871.

22 to 23 Sept. Enterprise in Transition, The Commonwealth Institute, Kensington, London. Tel: (01908) 373311.

30 Sept to 2 Oct. International Conference on Simulation Innovation Through Simulation, University of York, York. Tel: (0171) 240 1871.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, Electronics and Beyond, P.O. Box 3, Rayleigh, Essex SS6 8LR or e-mail to swaddington@cix.compulink.co.uk.

What's On?



ISI Guarantees Millennium Compliance

Following the announcement of the government's initiative to tackle the Year 2000 issue, embedded chip operating system developer ISI issued a plea for the semiconductor industry to accelerate testing to guarantee Year 2000 compliance for electronic products and systems, the 'forgotten components' of the computer systems at the peril of the 'millennium bug'.

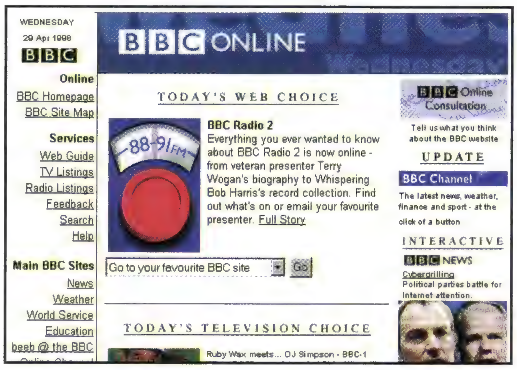
ISI, which received validation for the Year 2000 compliance of its own embedded operating system more than a decade ago, pledged to highlight the dangers facing companies deploying electronic systems that cannot function past the Year 2000.

ISI provides the operating systems for chips embedded within consumer products such as mobile telephones, fax machines, printers and video recorders as well as control applications such as traffic lights and machinery control systems.

"Computer software has been billed as the heart of the Year 2000 problem, but embedded electronic systems are the nerve centre and they have been ignored so far. There are literally billions of them out there, with the added complication that it is not always known what electronic systems or products with embedded chips are date-reliant. If they are date reliant, they need to be Year 2000 compliant," said Mike Osler, general manager, ISI.

"We are talking here about the most critical of applications. Embedded software affects dozens of life-critical systems in the health service, ranging from drug administration equipment to radiology or dialysis machines. Also of great concern are the automotive and avionics industries, where communication or system failures could be life threatening. Non-critical devices incorporating embedded software are everywhere; for example, air conditioning, lifts, video recorders and burglar alarms," added Osler.

ISI has developed a paper outlining the Year 2000 issue as it relates to embedded products outlining details of the testing procedure used to guarantee compliance of its embedded real time operating system products.



WEDNESDAY
29 Apr 1998

BBC Radio 2
Everything you ever wanted to know about BBC Radio 2 is now online - from veteran presenter Terry Wogan's biography to Whispering Bob Harris's record collection. Find out what's on or email your favourite presenter. Full Story

Ruby Wax meets... OJ Simpson - BBC-1

Tell us what you think about the BBC website

The latest news, weather, finance and sport - at the click of a button

Cybergrilling
Political parties battle for Internet attention.

BBC Director-General Warns of a Knowledge Underclass

Britain and Europe will see the growth of a knowledge underclass unless Governments and broadcasters continue to ensure that public service broadcasting in the digital age remains universally available to all, warns BBC Director-General John Birt.

Speaking to a meeting of top European broadcasters in Birmingham on April 6, Birt said, "The consumer will be increasingly asked to pay directly for what they see. The cost of watching a screen will rise enormously. We will see the emergence of the information rich, and the information poor. We risk a knowledge underclass."

He said that public policy in the digital age should ensure that public service broadcasting remains universally available.

"At the heart of the public broadcasting tradition is universality – reaching out to every household in the land – the poor and the prosperous – offering enriching experience and information which extends understanding. Public service broadcasters seek not only to delight, but to give individuals the knowledge they need to live fuller, more satisfying lives."

He said the purposes of European public service broadcasters should remain exactly the same in the digital age, that is nurturing and developing the extraordinary richness of each of Europe's unique national cultures, widening individual horizons and deepening personal experience with programmes about science, history, the arts and nature.

Outlining the risks of the technological revolution, he warned that globalisation of the media could undermine national cultures.

"That ubiquitous soft drink world of jeans, trainers and the baseball cap will advance inexorably. We cannot halt the advance with barriers or quotas. Nor should we. One of the glories of the modern world is being exposed to the best of other cultures. Rather, the drive of public policy should be to sustain individual national cultures. There is no more effective way of doing that than by encouraging a flourishing public service sector in each EU member country."

He continued, "In the space of 12 months or so the BBC will have introduced three new publicly funded channels, focused on news; learning and on enhancing our existing services."

He said the BBC will offer greater convenience to our licence payers. He highlighted the BBC's News 24 channel, offering news as it breaks; and BBC News Online at www.bbc.co.uk, offering instant access, via the Internet, to the world's most powerful force in newsgathering.

John Birt called for effective regulation of the digital gateway at national and EU levels to avert dominance of powerful gateway controllers – those who control access to digital screens – and to encourage openness of digital systems to a diversity of voices and a plurality of provision.

"Public broadcasters have a critical role to play in raising consciousness about these matters, and – through our educational services – enabling individuals to acquire the necessary skills. The BBC will play its part in the UK. But unless everyone – and most especially government – puts their shoulders to the wheel and tries to advance the Digital Society, we shall take too long to achieve lift-off."

Life-Long Learning for Engineers Essential

The accelerating pace of technological advance, global competition, demand for customised products, flexible business practices and social and political change all mean huge challenges for professional engineers. This was the message given at the Annual Dinner of the Institution of Electrical Engineers by IEE President, David Jefferies, who is Chairman of the National Grid Company plc, and was addressing an audience of over 1,500 at London's Grosvenor House.

"I welcome the fact that the Government has acknowledged the importance of life-long learning for all, but for professional engineers, and the companies that employ them, life-long learning is not optional but essential" said Jefferies. "The range and depth of engineering knowledge is expanding so rapidly that a good engineering degree has a 'half life' of only four years. Keeping abreast of new technology is vital".

• • • • • • • • • • • • • • • • • • • •

Young Amateur of the Year 1998

The search is now on for the Young Amateur of the Year. Anyone under the age of 18 can be nominated, and the closing date for nominations is July 31. The award is co-ordinated by the RSGB in conjunction with the radiocommunications Agency who will present £300 to the winner. Both the winner and the runner-up will receive an invitation to the Agency's Radio Monitoring Station at Baldock, Hertfordshire.

Anyone wishing to apply for this competition should request an application form from Marcia Brimson, 2E1DAY, at RSGB Headquarters on (01707) 659 015 as soon as possible.

AIR YOUR VIEWS

E-mail your views and comments to:
AYV@maplin.demon.co.uk

Write to:
Electronics and Beyond,
P.O. Box 777,
Rayleigh,
Essex SS6 8LU

Improving Safety Standards

Dear Sir

The recent item on safety of test meters and equipment (May 98) highlight just how methods and working practices have changed not to say the least to greatly improve health and safety to the operative.

When I joined the electrical trade in the 50s the 'test equipment' consisted of the neon screwdriver and a lampholder with a couple of short length of flex with the ends bared as 'probes', plus a lamp you borrowed from where you were working at the time.

A continuity tester for unpowered circuits was a bell and battery otherwise it was back to the lamp in series with the mains. As a proportion of fault finding was on three phase industrial equipment there was also the 440V tester – two batten holders screwed back-to-back and wired in series.

The first time I actually saw a 'proper' test meter was when I built one in the 60s from a kit of parts that used an ex-government '19 set' meter conveniently calibrated 0-3 and 0-15 for Volts and milliamperes, but unfortunately uncalibrated on Ohms range.

M. Perry, Worcs

A real Heath-Robinson way of working, but as you so rightly say, its a relief that working practices have vastly improved.

Superfluous Apostrophies!

Dear Sir

If Dougal Paterson mourns the demise of the English million (billion? – May 98), then may I enter a plea of mercy for the much abused apostrophe?

In another letter on the same page lurks:- "Having enjoyed 'Electronics' for almost all of it's issues….". This growing trend for inclusion of superfluous apostrophes, is no more correct than it would be to say that something was her's or even hi's. It's is short for it is or it has. However, I was hardly prepared for the comprehension trap hidden in Part 3 of 'Building and Upgrading PCs' (June 98):-

"Now for the big one…." – it starts, ominously – "…Its the one with five connectors and a twisted bit of cable in the middle. The connector on it's own….." Ouch! That poor apostrophe must be squirming with embarrassment, looking with dismay at the preceeding sentence.

Any living language must evolve, and some tides of change become overwhelming. However, in our subject of electronics, where precision of expression is vital and compilers baulk at syntax errors, why make comprehension for us mortals that little bit more difficult?

Please spare a though for the poor apostrophe! It's very handy, but only when its usage is correct!

Martin Whiley
Middlesex

Your plea for mercy has been accepted, and we will try harder!

• •

A Line Behind

Dear Sir

I'm not sure that the 'On Screen Video Level Meter' (May 98 issue 125, page 17) works exactly as described.

The dot that indicates peak level for each line can not appear on the line to which it pertains. Take as an example a generally dark line which has a slightly brighter level at the rightmost end. The correct place for the dot would be well over to the left. But, the line would have nearly completed scanning to the right before this fact can be determined, and by then its too late to place the dot!

No, I suggest that the sample-and-hold circuit (IC8) overcomes this problem by holding the previous lines' value on its output (C14) while measuring the current line. Hence the actual (measured) video level dot is placed on the screen one line too late – hardly noticeable, The final dot is lost during the field blanking periods. The very first line has no dot at all, but as this line is probably 'displayed' off the top of the picture tube face, no one notices! Am I correct in the these assumptions? as I did not feel that this explanation was apparent from the article.

Dr. G. L. Manning, Middlesex

Ian Berry replies

The answer to your question is yes, the operation of the unit is exactly as you as you have indicated. It is obvious (or at least I thought it was!) that the indicated level is actually the video level on the previous line. This must be so or the video level at the extreme right of the picture could not be measured. However, as you also point out, it is virtually impossible to see this one line delay, indeed the only way to actually demonstrate that this is the case would be to have a single television line of white in an otherwise black frame and then attempt to see the tiny block of indicated white level. Mind you, when using a waveform monitor to set camera video levels in a studio or outside broadcast truck it is usual to watch a display at line rate which has the level of all the lines in a single frame superimposed on top of each other so that the maximum level is indicated without regard to its position in the frame. As you will no doubt appreciate, it is the indicated level which is important rather than where it is situated. You are also correct when you point out that this is not brought out in the text as well as it might be. My only defence to this is to say that I already know how the unit works, the difficulty lies in attempting to describe this to others and perhaps things I think are 'obvious' may not be.

There is another issue which may not have been fully taken into account. The display does not actually begin at the top of the frame, nor does it extend to the very bottom of the frame. The reason for this is due solely to the very simple method of deriving the vertical blanking pulse using only one IC. The timing sections of the 4528 are not accurate and stable enough to give a blanking period which is exactly to TV specifications. The only way to do this would be to use a line counter circuit which would make the unit much more expensive. Therefore, the blanking is set to begin a few lines down the picture and end a few lines before the bottom, so the timing can wander a little and is not noticeable. In practice this is acceptable, as the point of interest to be measured is usually at the centre of the picture. The Level Meter is not presented as a precision instrument but merely as a quick and handy way to check camera exposure.

Radioactivity

A CENTURY OF CONTROVERSY

PART 2

Natural radiation is the topic for discussion in the second part of this series by Greg Grant

Radon

Generally speaking, the world today is well aware of what science was totally unaware of a century ago - we are exposed to radiation throughout our lives. Radiation of course means disintegration, involving a particular atom changing from one element into another, in the course of which it emits either a spurt of electromagnetic energy, or an electrically charged particle.

All the metals in the earth's crust are radioactive, to a greater or lesser extent and, as we have seen, one of the most widely dispersed metals is uranium. This element's radioactive changes creates a lengthy list of radioactive substances, one of which is the gas Radon.

Radon was first discovered, or rather hinted at, in 1899, by Ernest Rutherford. He had been experimenting with Thorium and noticed that it produced a gas which he termed Thorium Emanation. In the following year the Polish-born German physicist Friedrich Dorn began a study of the radium the Curies discovered.

He subsequently found that the element not only gave off radiation, but a gas also. This gas itself proved to be radioactive and so Dorn called it Radon.

This gas turned out to be the sixth Noble Gas, indeed the most complicated of the Noble, or Inert, gases its atoms having electron shell arrangements containing 2, 8, 18, 32 and 8 electrons. Moreover, being composed only of radioactive isotopes, it is a difficult element to carry out chemical experiments with.

Radon will naturally decay. The element's most stable isotope, Radon-222, breaks down, releasing alpha particles into the atmosphere as it does so. Indeed, this isotope is a common source of the alpha particles used in radio therapy.

Gamma

In 1900, the French physicist Paul Villard was studying uranium radiation under the influence of a magnetic field. He noticed that, in addition to both alpha and beta rays, there was another form of radiation, one that was unaffected by a magnet. The new radiation's properties appeared to resemble those of X-rays, except that it was even more penetrative and, therefore, of even shorter wavelength. This radiation in fact has a wavelength in the range 1 x 10^{-9}m to 1 x 10^{-11}m metres. To this particular form of

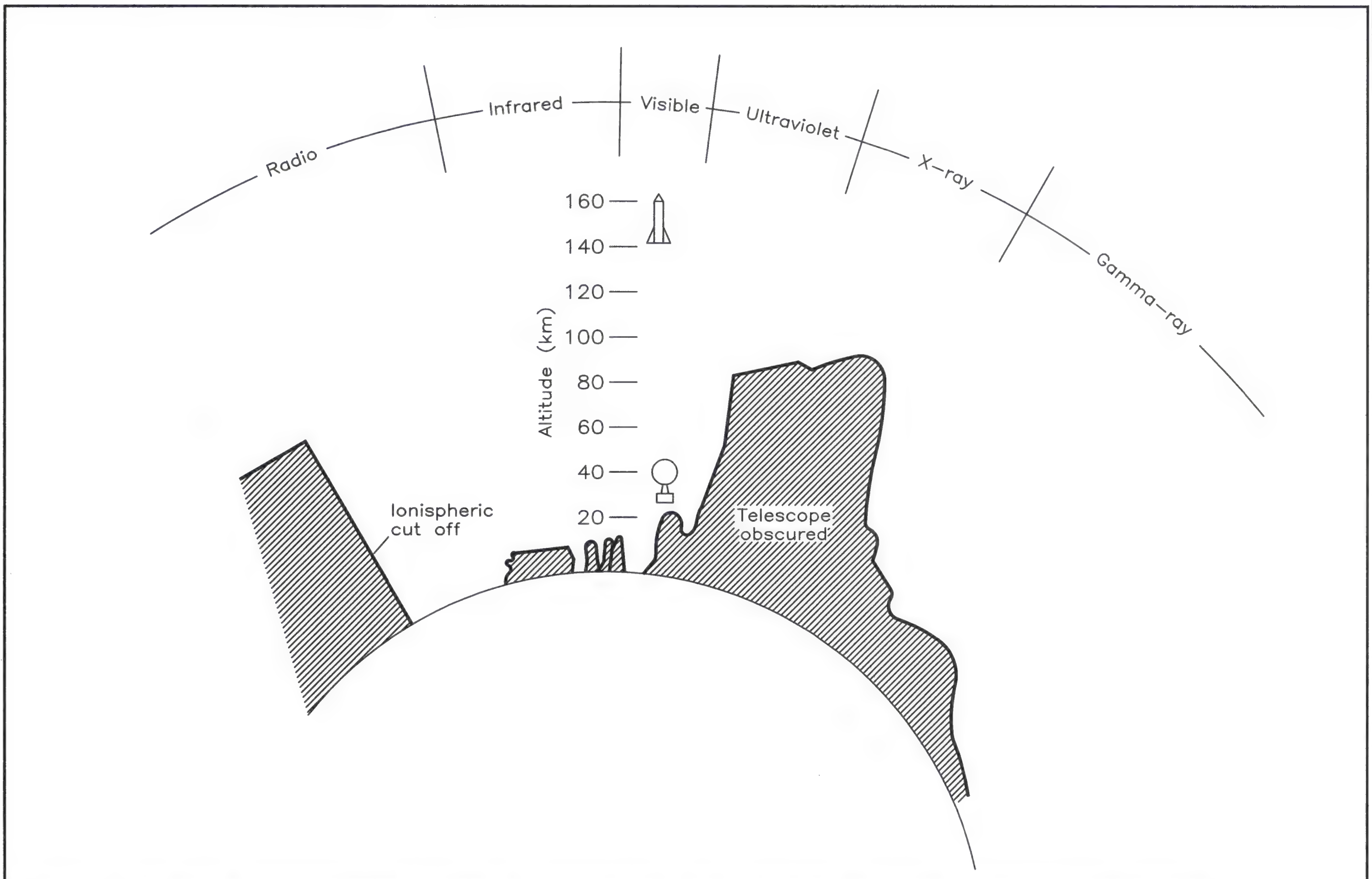


Figure 1: The height in the atmosphere below which observations cannot be made throughout the electromagnetic spectrum.

adiation Villard gave the name Gamma, the hird letter of the Greek alphabet.

These rays originate in atomic nuclei during radioactive decay. The absorption of gamma rays by nuclei can cause particles to be ejected - a phenomenon termed photodisintegration - or can even split the nucleus, known as photofission.

Gamma ray photons lose energy by being scattered from free electrons - the Compton Effect - or are completely absorbed by ejecting electrons from atoms, which is the process known as the Photoelectric Effect, he explanation of which won Albert Einstein the Nobel Prize in Physics in 1921.

Recent research has shown that some "...three times a day our sky flashes with a powerful pulse of gamma rays. The sources of this intense radiation are likely to be emitting, within the space of seconds or minutes, more energy than the sun will in its entire 10 billion years of life." [1]

Cosmic

In 1786, the British inventor, and physicist, Abraham Bennet invented the gold-leaf electroscope which consisted of two slivers of gold leaf, joined at the top, the whole held in a sealed jar. The slivers could be electrically charged from the outside and, since they received the same charge, they repelled each other resulting in an inverted 'V.'

When really energetic radiation penetrated the jar it produced ions, which accept the electric charge, thus enabling the slivers of gold leaf to slowly come together again. Therefore, when no really energetic radiation was present, for example X-rays or Gamma rays, the slivers should have remained apart indefinitely. However, this did not happen: the slivers almost always sunk slowly together.

By the opening years of the present century, science knew that small amounts of radiation emanate from radioactive metals in the rocks and soil. This, it was thought, could well account for the slow leakage of the electroscope's charge. Fortunately there was a way of proving this too - detach the earth from the equation.

In 1910, the French physicist Theodor Wulf was carrying out radiation experiments at the Eiffel Tower. In the course of this work, he noticed that the ionisation in the air 300m above the Gamma ray source he was using was greater than that at a similar horizontal distance from the source. This, he thought, could indicate an extra-terrestrial source for the radiation, and he went on to suggest that his hypothesis could be tested using a balloon.

In the following year the Austrian physicist Victor Hess, working at Vienna's radiation research laboratory, was also concerned with locating the source of the background radiation which "...showed up as ionisations in the air, even within containers that were shielded." [2]

In 1911, Hess took up Wulf's suggestion and, with the assistance of the Austrian Aero Club, he made 10 balloon flights with an electroscope, collecting ionisation data to a height of some 5,350 m. His results were, to say the least, surprising. The gold slivers of his electroscope came together some eight times more rapidly at altitude than they did at ground level.

Ionisation in fact decreased from ground level to about 150m, but from that point upwards it increased noticeably with increasing altitude. Moreover, the radiation at all levels was the same, during day or night, and so could not be the result of sunlight. Hess, in fact, had established the existence of Cosmic rays, which he termed Hohenstrahlung, the German word for 'Radiation of the Heights.'

Cosmic rays in fact are any class of energetic particles which travel through space at speeds approaching that of light. In the 1920s, the American physicist Robert A. Millikan took the lead in balloon experiments. He, in 1925, suggested the name Cosmic rays for what Hess had discovered. The word Cosmos is a Greek word meaning Order, in particular Good Order, thus highlighting the Greek concept of the universe forming an ordered whole.

There are two basic cosmic rays: primary and secondary. Primary cosmic rays are, principally, hydrogen nuclei, that is protons and Alpha particles, or helium nuclei. Some primary particles are generated by the nuclear convulsions taking place in the sun via solar flares. However, the vast majority come from the most remote areas of the universe possibly, it is thought, from exploding supernovas.

The fact is however that "...no laboratory on earth . . can . . produce the equivalent of cosmic rays at billion-volt energies, which is the chief reason why we know so little about what happens at the top of our atmosphere when cosmic rays strike." [3]

Secondary cosmic rays result from Primary cosmic rays entering the earth's atmosphere and colliding with nitrogen and oxygen nuclei. Such secondary rays consist of positrons, neutrinos and other sub-atomic particles as well as very small quantities of photons. Particularly energetic secondary cosmic rays may interact with other atmospheric nuclei and create even more secondaries which, in turn, themselves generate what is known as a Cascade Shower.

Electrons comprise only some 1% of cosmic rays and the collisions in the earth's atmosphere result in a considerable number of radioactive atoms. Although this collision-created radioactivity does not greatly add to the natural, terrestrial radioactivity, it does provide a useful source of trace elements which can be used to study a variety of subjects on earth.

Indeed by 1946 it was becoming evident "...that somewhere in the process of radioactivity there were clocks to be found." [4] Six years earlier, the Canadian-born American biochemist Martin Kamen had discovered the Carbon-14 isotope, "...formed by the reaction of cosmic ray particles with nitrogen-14 in the upper atmosphere." [5]

This isotope had a lengthy half-life of around 5,700 years and, in 1947, the American chemist Willard Libby saw that this could be usefully employed in historical dating. Since new carbon-14 was formed as old carbon-14 broke down radioactively, a balance was achieved and a very small amount of the isotope always remained in the earth's atmosphere. Libby thought that, since plants absorb carbon dioxide in the course of photosynthesis, carbon-14 would be absorbed also.

When the plant died however, the carbon-14 it had absorbed hitherto would slowly break down. So, by measuring the carbon-14 concentration in a dead plant or piece of wood, the elapsed time between the plant's demise and the carbon-14 could be measured quite accurately.

This meant that samples of wood, textiles, parchment and other substances could be accurately dated. Archaeology no longer needed to depend on estimates and guesswork when dating ancient artifacts.

Ultra-Violet

Visible light, of course, is not the only form of light. If - for example - a photographic plate is placed beyond the violet end of the spectrum, where nothing is visible, it becomes strongly fogged. This fogging is caused by Ultra-Violet light, from the Latin word for 'Beyond.' This form of radiation is still termed 'black light' occasionally and commonly abbreviated to U-V.

It was discovered as early as 1801, by the German physicist Johann Ritter, who was working with silver chloride. He found that his accidental discovery affected the silver chloride more than visible light did. By 1879 the British astronomer William Huggins had obtained the ultra-violet spectrum of white stars.

Ultra-violet radiation is produced by high temperature surfaces such as the sun, in a continuous spectrum. In fact "...apart from visible light and radio waves the only other radiation which penetrates the atmosphere is the longest wavelength ultra-violet and small parts of the infra-red." [6] It is also produced by atomic exitation in gas discharge tubes as a discrete spectrum of wavelengths.

The ultra-violet spectrum is usually divided into two regions. Firstly there is the Near U-V, towards the visible spectrum, with a wavelength of 2,000 to 3,800 Angstroms (Å), and secondly the Far U-V region, having a wavelength range of between 100 to 2,000 Å.

In the past, research aircraft and specialist balloons were able to approach the sort of altitudes suitable for gamma-ray and infra-red astronomy. However, in the case of the "...ultra-violet and X-ray regions there is no alternative but to use rockets or satellites." [7]

Infra-Red

Just as there is 'light' beyond the violet end of the spectrum, so there is also another form of 'light' beyond the red, or opposite, end of the spectrum. Visible light with the longest waves is seen by humans as red. Light with even longer waves is invisible and termed Infra-red, the 'Infra' coming from a Latin word meaning 'Below.' This form of radiation was discovered as long ago as 1800, by a German-British music teacher called William Herschel.

He had become interested in astronomy, but could not afford a decent telescope. Consequently he decided to build his own equipment and began by grinding the mirrors and lenses. The result of this initiative was that Herschel telescopes were among the finest of the time.

Herschel was investigating the power of different parts of the spectrum to heat a thermometer, when he noted that temperature rose towards the red end of the spectrum. He then decided to move his thermometer slightly beyond the red end so as to monitor the heating effect's termination point. To his surprise, the temperature rose higher than ever at a location beyond the spectrum's red end. Herschel subsequently published his findings in his paper 'An Investigation of the Powers of Prismatic Colours to Heat and Illuminate Objects.'

In 1850 the Italian physicist Macedonic Melloni, the inventor of the Thermopile, used his discovery to investigate the infra-red radiation Herschel had discovered. His device could detect both very weak electric currents and very low heating effects also. Consequently, Melloni was able to show that infra-red radiation had all the properties of light, including interference and polarization. It therefore consisted of waves, as indeed did light, except that in the case of infra-red, the waves were too long to make an impression on the retina of the human eye.

By 1887, the British photographic physicist William Abney had developed techniques for detecting infra-red radiation photographically. He later used his development to observe and photograph the sun's spectrum.

Eighteen years later the American physicist and astronomer William W. Coblentz began a 40-year spell as head of the Radiometry Section of America's National Bureau of Standards. Throughout a long and most prodcutive life, Coblentz measured the infra-red radiation from planets, stars and nebulae. He was the first physicist to accurately establish the constants of black-body radiation, confirming Planck's Law in the process. He was also a major influence in the adoption of radiometric standards.

The infra-red spectrum is usually divided into three ranges. The Near infra-red band is that closest to the visible spectrum, having wavelengths of 0.78 to 30 x 10^{-6} metres. Middle infra-red has a wavelength range of 3 to 30 x 10^{-6} metres, whilst the Far infra-red begins at 30 x 10^{-6} metres and extends to 300 x 10^{-6} metres. Indeed most of the radiation emitted by a moderately heated surface is infra-red.

Presently our knowledge of the infra-red region - as with the U-V region - depends on satellites, a number having been "...placed in earth orbit to make astronomical observations particularly in the X-ray (Uhuru) and infra-red (IRAS) wavelengths." [8] The latter, a co-operative effort of The United States, the Netherlands and the United Kingdom, is equipped with a 57-centimetre infra-red telescope, sensitive to wavelengths of 8μm to 100μm. It has already made a number of important - indeed unexpected - discoveries, among the most important being clouds of solid debris around a number of stars.

All of the above of course leads to one thing: the measurement of radiation itself and its effect on workers in the field and the public at large. In the next part we shall look at the somewhat confusing world of radiation measurement.

References

1: *Fishman, J and Hartmann Dieter H. (1997): Article 'Gamma Ray Bursts' in the July 1977 Issue of the 'Scientific American' journal.*

2: *Weber, Robert L. (1988): Pioneers of Science. Adam Hilger, Bristol. Page 104.*

3: *Wilson, David (1975): Atoms of Time Past. Allan Lane, London. Page 72.*

4: *Ibid [3], Page 55.*

5: *Brooks, Jim (1985): Origins of Life. Lion Publishing plc., Tring, Herts, England. Page 34.*

6: *'Times' Atlas of the World. Comprehensive Edition. Times Books, London, 1990. Page xxiv.*

7: *Porter, Richard W. (1977): The Versatile Satellite. Oxford University Press, Oxford. Page 138.*

8: *Ibid [6], Page xxv.*

SERVICE MANUALS
& TECHNICAL BOOKS

CRASH PRICE

We now have 8 Monitor CD-ROM's

On our CD-ROM's

Due to the success of our CD-ROM compilations we can now offer them at a new reduced price of just £24.95 each (plus VAT). Now there is even more reason for you to change to this method of data purchase. Why spend £££'s on individual manuals when you can get dozens on just 1 CD-ROM and save a fortune.

Coming soon - TV Manuals on CD-ROM

DON'T DELAY - ORDER TODAY
Full details on the contents of each CD-ROM shown on our web site and our free PC Disc
All orders plus post/packing £2.94

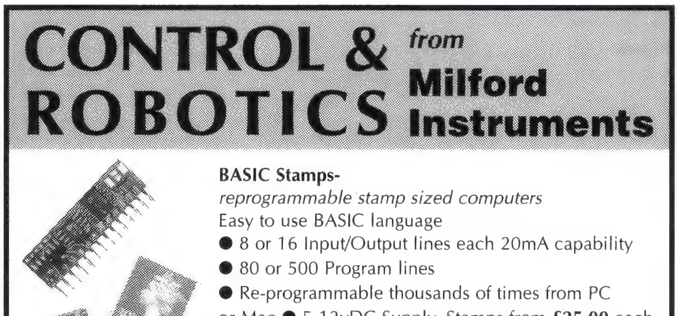
We have the largest range of Service Information and Technical Data obtainable anywhere.
For Televisions, Video Recorders, Test Equipment, Computer Monitors, Vintage Wireless, Domestic Equipment etc etc.
In fact practically anything electronic.
Originals or Photostats as available.

Also available. Our catalogues on PC Discs detailing Hundreds of Technical Books and Repair Guides. Return coupon for your FREE Discs. The entire index of manuals we have is available on PC disc for just £5.00 inclusive with FREE updates.

MAURITRON TECHNICAL SERVICES (EB)
8 Cherry Tree Road, Chinnor, Oxfordshire, OX9 4QY
Tel:- 01844-351694. Fax:- 01844 352554.
Email:- sales@mauritron.co.uk Our catalogue is now on the Web at http://dialspace.dial.pipex.com/mauritron/

Please forward your PC Discs catalogues of CD-ROM'S and Technical Books for which I enclose 4 x 1st Class Stamps.
Please supply Index of manuals on PC Disc for £5.00 inclusive.
Circle items required

NAME ____________________
ADDRESS ____________________
____
POSTCODE __________ You may pay by Cheque, PO or Visa, Access, Delta, Electron, JCB, Mastercard, Eurocard etc
☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐
EXPIRES__________ SIGNATURE __________



CONTROL & ROBOTICS from Milford Instruments

BASIC Stamps-
reprogrammable stamp sized computers
Easy to use BASIC language
- 8 or 16 Input/Output lines each 20mA capability
- 80 or 500 Program lines
- Re-programmable thousands of times from PC or Mac
- 5-12vDC Supply. Stamps from **£25.00** each.

Development Kits including programming software, Stamp, Cable, Project Board and 25+ Application notes from **£79.00**.

MUSCLE WIRES
Wires that contract approx 5% when heated (eg 250mA current) -120 page Project book and 3 one metre lengths of wire. **£40.00**

STAMP BUG
Autonomous roving insect using the BASIC Stamp as its "brain". Approx 300mm overall length.
KITS FROM **£29.00**

LYNX ARM
5 Axis robot arm kit; approx size 300mm.
Control from any serial comms port or Stamp.
Includes software to run from PC. KITS FROM **£85.00**

All prices exclude VAT and shipping.
For a full catalogue of the above items and other products, please call or fax Milford Instruments at 01977 683665; Fax 01977 681465.

COMMENT

by Keith Brindley

It's that Millennium Bug Again!

If you've seen or read any news item recently, there's a good chance it's about the so-called Millennium Bug – the 'effect' that will occur in many computers or computer-operated equipment one second after midnight on the night of the 31st of December 1999 (more correctly, the very first second of the first day of January year 2000). The Government has stoked new life into the fire in recent weeks with its high profile involvement to help get rid of it.

In reality, it's not a computer bug at all of course, and what's more while all associated effects will cause the same kind of results, it's not a single problem either. The problem, or indeed problems, will arise if a computer or computer-operated equipment, or even a single microprocessor, is unable to differentiate between the year 2000 and the year 1900. In simple terms, any computer equipment which uses a two number specification for yearly date (ie, 97 for 1997, 98 for 1998, 99 for 1999 and so on) will encounter difficulty as the year changes to 2000 – when its representation for the year becomes 00, which can be mistaken for 1900. Now while humans can differentiate between year 2000 being represented by 00 and the year 1900, computers are thick and they need to be told. As such, inordinate confusion will be caused by computers which can't differentiate the year 2000. It's worth pointing out here that this isn't the only year 2000 concern. There are others, including the fact that year 2000 is a leap year and many computers don't actually know that!

But let's put this into perspective. Computers can't be blamed for this. As I've said, they're thick and need to be told the difference between 1900 and 2000. A computer can only perform or carry out a task if it's properly told how to do the task. That's what a computer program is there for – to instruct a computer how to do the task. In other words, it's not the computer that's at fault, it's the people who have written the software to control the computer!

In computer terms, there are three areas where the millennium bug affects its operation. First is its internal basic controlling program – its BIOS. Remarkably, till just recently some computers have been produced with a BIOS that simply cannot differentiate between 1900 and 2000. Is that stupid, or what?

Second is the operating system software that a computer needs to present an interface between its human user and its integral parts. Interestingly, the majority of personal computers worldwide (and of course we are talking about those that run Microsoft Windows here) are not year 2000 capable. Believe it or not, it was not until 1995 (on the release of Windows 95) that Windows itself became able to differentiate between 1900 and 2000. Is that stupid, or what?

Third are the application programs that individual computer users run. It's impossible to say whether these are year 2000 compliant or not, although most (not all) of the famous applications have been for a while now. Is that stupid, or what?

But these are just computers. It's relatively easy to check if a computer is year 2000 compliant. While this is a simplification of the problem, you can simply adjust its internal date to year 2000 and run it to make sure it all works properly. If it doesn't work, you can replace the offending part be it the BIOS, the operating system or the application program. You can always swap the whole thing for a setup that is year 2000 compliant. So this problem is controllable by the user planning ahead, even though the original manufacturer or software producer wasn't planning ahead when the computer or software was first designed. This is simply damage limitation at its costliest.

The Problem Gets Worse

A bigger problem though is with computers within other devices. Every videocassette recorder for example, most modern kitchen appliances, televisions, telephones and so on all have an internal microprocessor. If the 'bug' is in that, there's a likelihood such an appliance might not work properly in the year 2000.

If you have no idea of the consequences that will face us on the morning of 1st January 1998, reach for the book *Time Bomb 2000: What the Year 2000 Computer Crisis Means to You!* by Edward Yourdon and Jennifer Yourdon (published by Prentice Hall: ISBN 0130952842), from which the above facts have been gleaned. It is as well a resourced and descriptive explanation of the year 2000 problem as you are likely to see in print. Better than that, it's written in a non-technical way, such that even the most non-technical person will be able to see the problems that face us. It is indeed one of the only books written on the topic not for programmers or IT professionals, yet just as relevant to them. It is also very frightening, but remains non-alarmist. When we wake up with the largest hangover of our lives from the Millennium New Year's Eve Bash we all attended the night before, it's just possible that the hangover won't go after a couple of hours. From this premise the book lays out the scenarios we might face.

The stupidest things about this whole sad Millennium Bug affair are that 1) it has been made by computer or microprocessor manufacturers and software producers, 2) computer or microprocessor manufacturers and software producers have left it until the last few years of the present millennium to try to correct their errors. These errors should never have been there in the first place. It makes me glad my computers are Apple Macintoshes. The very first Mac was produced in 1984. Then it had a BIOS that would operate to the year 2040 (current Macs, incidentally, will operate to AD 29,940) and an operating system to match. Consequently only a few application programs ever to run on a Mac (funnily enough, Microsoft Excel being one of them) weren't totally year 2000 compliant from day one in 1984. Why didn't other computer makers and software producers do the same? Didn't they believe their products would be around in the year 2000? Coincidentally, one of my Macs is a 1984 model which still works perfectly well, even if a little slow by modern standards. I use it for menial tasks like email and surfing the Internet. Whats more, I know it will still do these jobs in the year 2000 too (that is, if the Internet's still working).

My personal feelings about PCs aside, the pure fact of the matter (as the authors of *Time Bomb 2000* explain methodically and clearly) is that we do not yet know how the world is going to cope after 1st January 2000. Most of life will go on as normal no doubt, but there will be some computer systems affected. There is simply no way that all systems can be guaranteed to function correctly as there are just too many systems in the world for this to be the case. Just what the effects of these failed computer systems will be is only going to be known when they fail, and as the failures begin to ripple down through the world's socio-economic strata. The fact your VCR might no longer be capable of being programmed to record your favourite TV program is small fish. But if your bank's computer is offline for several weeks and can't give you cash you may not be so nonchalant.

Tick, tick, tick, tick
"Happy New Millennium" – BOOM!

The opinions expressed by the author are not necessarily those of the publisher or the editor.

Get more from VISUAL BASIC 3

PART 4

This month Mike Holmes explains DOS and Interrupts.

Soon after version 1 of Visual Basic for Windows first appeared, there followed a variation on the theme for users who could not yet afford the then new-fangled and highly expensive IBM PC AT (Advanced Type) machines, which were needed to be able to run Windows. This variation, for all intents and purposes identical as much as possible to Windows' Visual Basic, was called Visual Basic for DOS, and allowed Windows-like programs to be created to run on XT machines (even those with EGA and lower monochrome monitors), having Windows-like behaviour including mouse support.

Actually, I still quite like Visual Basic for DOS – it's 'quaint'. What's clever about it in particular is that, although its screen displays are supposed to be graphically orientated (like Windows proper) rather than purely text based, as is usual with DOS programs, it does not need a special graphics screen mode. All 3D objects are drawn using the box drawing characters provided with the standard DOS ASCII set, retaining the minimum required DOS text screen. Hence, Visual Basic for DOS (hereafter referred to as VB-DOS) still works with a 2 or 4-bit monochrome amber or green screen monitor for an XT.

The only deviation from normal DOS screen working is to do with colours. DOS normally has eight basic colours, eight 'bright' colours (the same again but intensified), the latter then duplicated as 'flashing' (using an extra attribute bit). In keeping with its Windows-like appearance, VB-DOS adopts a different Windows equivalent 16 colour set, in the process of which the flashing attribute is sacrificed (it is utilised to achieve the non-DOS shades).

Interestingly, VB-DOS does not by default display colours – its default is viewable as 4-bit monochrome, that is to say white (grey) on black, the black being used for the lower right shadows of objects, and bright white being used to highlight the top left 'lit' edges of objects (such as command buttons). The backgrounds of windows and controls are a uniform grey and the text is black.

To force VB-DOS to display a greater variety of colours, some sort of initialisation file listing these, and a means for reading it at start-up, must be provided for every VB-DOS program, or with values set in start-up code.

For some time now many commercial DOS programs – particularly utilities and installers – tend not to be boring flat 2-bit white on black. Borders, pop-up boxes, drop-down menus and progress bars abound, and are in colour. Figure 1 shows a typical example (if you recognise it you'll know what it is) – albeit not produced with VB-DOS, the same principles of generating a graphics-like display using standard DOS ASCII characters apply, even to the point of including shadows for an enhanced 3D effect. Significantly, however, this method is very much faster than drawing in graphics screen mode.

The one drawback to VB-DOS is that it is memory hungry – any compiled EXE will never be much smaller than 240K. This is because of the runtime library that goes with it that makes it all work. Similarly, the design environment needs a lot of memory, even though an overlay technique is used, and experience has shown that it is happiest when EMS is available. Still who needs an AT then!

Compatibility

VB-DOS is compatible with all previous versions of Microsoft QuickBasic. This is useful to know if you still use QuickBasic, since you can use VB-DOS instead of QuickBasic to make simple (non-windowed) DOS programs. The one thing you can't do is use PRINT or INPUT if a window is loaded, as PRINT and INPUT are 'not allowed while a form is showing'.

The following compatibility guidelines apply when porting applications from Visual Basic for Windows. This can be done fairly easily, also from VB-DOS to VB for Windows – the only limitation being that often you cannot load a complete project of the other type – you usually have to make a new project then add the other's modules one at a time.

In the case of forms and controls, those for VB for Windows have many more properties than VB-DOS. This only means that VB-DOS 'dumps' the properties it doesn't understand. In the other direction, VB for Windows adds default properties to VB-DOS forms and controls where it finds them missing.

Microsoft recommend that the content of a global module be translated to a comparable $INCLUDE file. You include this file in each file in the project using the $INCLUDE metacommand. Formal parameters and all Dim, Dim Shared, Redim, Static, and Global statements must be changed to include appropriate AS clauses.

Functions used in VB for Windows code (.BAS) modules require insertion of the appropriate DECLARE FUNCTION statements in each file in the VB-DOS project. VB-DOS is funny like that.

Microsoft also recommend you use the statement 'CALL Main' in the project if the VB for Windows application uses 'Sub Main' as the start-up, although personally I use executable code in a first GENERAL.BAS module. In VB-DOS executable code can exist outside of a procedure.

The table below defines the most common statement and declaration relationships between both Visual Basic types:

Visual Basic for DOS	Visual Basic for Windows
COMMON SHARED X	Global X
DIM X, X()	Global X, X()
ON LOCAL ERROR	On [Local] Error
DIM SHARED	Dim statements (declaration level)
STATIC X	Static X (procedure level)
REDIM PRESERVE X()	ReDim Preserve X()

Invoking VB-DOS – Recommendations

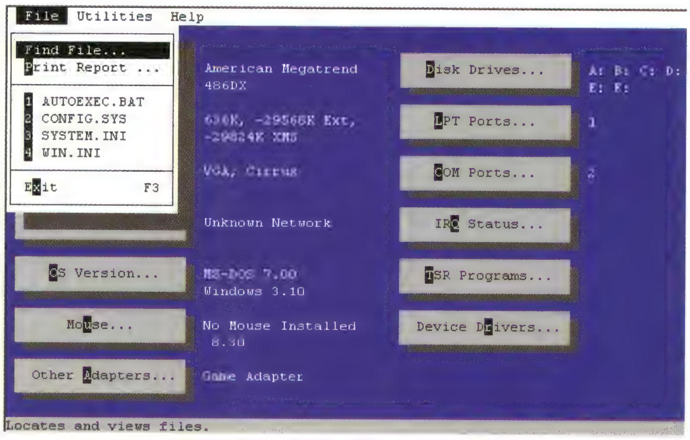
The VB-DOS design environment is run from the DOS prompt as follows:

```
VBDOS [options] [[/RUN] program]
[/CMD string]
```

First of all, do make sure that it runs fast enough. Just typing 'vbdos' at the '>' prompt invariably means it runs very slowly. A surefire way to make it run aggravatingly slowly is to type:

```
VBDOS /S:300 /X:0 /E:0,0
```

VB-DOS is one of those programs that compiles a temporary EXE and runs it when



```
American Megatrend
486DX
630K, -29566K Ext,
-29824K XMS
VGA, Cirrus
Unknown Network
MS-DOS 7.00
Windows 3.10
No Mouse Installed
 8.30
Game Adapter
A: B: C: D:
E: F:
1
2
Locates and views files.
```

Figure 1. Example DOS application in a 'window'.

ou want it to run. The '/S:' option specifies he amount of DOS memory to reserve for he VB-DOS design environment. 300K is ot enough.

Plus, '/X:0' means don't use any XMS, and /E:0,0' means don't use any EMS. Assuming any of this is available in the first lace.) So I always use:

```
BDOS /S:400 project.mak
```

hich ensures maximum speed and fficiency, with EMS being detected and sed automatically ('project.mak' is the ame of the Visual Basic project to load or reate). This invokes the code editing part f the design environment, which (usually) ooks like that shown in Figure 2.

Making Even More Work Space – Library Linking

Eventually, however, a complex project will use up memory, so then it becomes prudent o begin making library modules of what's een written so far, exiting VB-DOS and re-running it giving it the library name to link. Microsoft provide one that enables VB-DOS o make DOS interrupt calls:

```
VBDOS /L VBDOS.QLB /S:400
project.mak
```

Building on this, I then created a further one that also includes Microsoft's provided Common Dialog module, along with some other standardised stuff I typically want to use.

This general purpose library link module is called 'projlib.qlb' and is linked by:

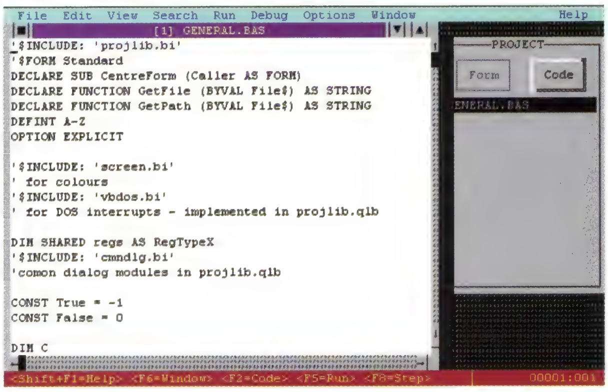
```
VBDOS /L PROJLIB.QLB /S:400
project.mak
```

For reference this library contains:

GENRLLIB.BAS	standard globally accessible routines
CMNDLG.BAS	Microsoft's common dialog code module
CMNDLGF.FRM	Microsoft's common dialog form module
CNCLFORM.FRM	a window displaying a 'Cancel' button
EDCOLORS.FRM	a window for changing system colours
CUSTHLP3.FRM	a Windows-like help display system
CUSTCOPY.FRM, CUSTHIST.FRM, SINDEX.FRM	copy, history and index search windows used by main help window

At compilation time this library also needs vbdos.bi to declare the DOS interrupt calls linked by VB-DOS as vbdos.qlb. Forms CustHelp, Cnclform, and Colors will be externally accessible to the new project along with utility routines in genrllib.bas.

My main project therefore typically uses projlib.lib as linked by VB-DOS when run, and containing at least GENERAL.BAS, optionally GETHELP.BAS, and a first form. This is ultimately run or compiled as myprog.EXE. At the code level it will include: projlib.bi, listing declarations of the relevant procedures and objects in projlib.lib; and cmndlg.bi doing the same for the common dialogue modules.


File Edit View Search Run Debug Options Window Help
[1] GENERAL.BAS
PROJECT
Form
Code
ENERAL.BAS
<Shift+F1=Help> <F6=Window> <F2=Code> <F5=Run> <F8=Step>
00001:001

```
'$INCLUDE: 'projlib.bi'
'$FORM Standard
DECLARE SUB CentreForm (Caller AS FORM)
DECLARE FUNCTION GetFile (BYVAL File$) AS STRING
DECLARE FUNCTION GetPath (BYVAL File$) AS STRING
DEFINT A-Z
OPTION EXPLICIT

'$INCLUDE: 'screen.bi'
' for colours
'$INCLUDE: 'vbdos.bi'
' for DOS interrupts - implemented in projlib.qlb

DIM SHARED regs AS RegTypeX
'$INCLUDE: 'cmndlg.bi'
'comon dialog modules in projlib.qlb

CONST True = -1
CONST False = 0

DIM C
```

Figure 2. Visual Basic for DOS, design environment code editor screen.

VBDOS.BI

Without going into great detail, this included file is for assembly language routines in vbdos.qlb called ABSOLUTE, INTERRUPT, INTERRUPTX, INT86OLD, and INT86XOLD. It allows a VB-DOS program to use, for example, 'Int24h' DOS routines.

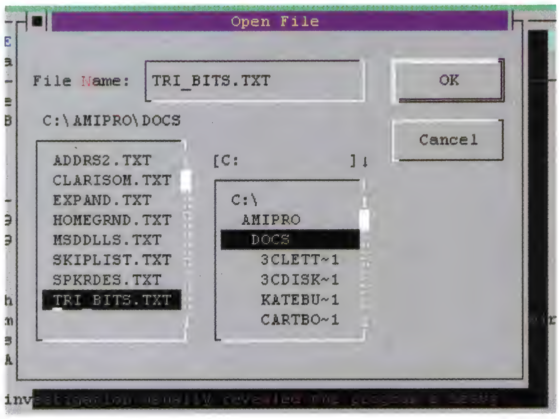
CMNDLG.BI

Lists procedure declarations for Microsoft's 'Common Dialog Toolkit'. These are public routines that display the relevant pop-up windows. These include About, FileOpen and FileSave (see Figure 3), FilePrint (see Figure 4), FindReplaceText (see Figure 5), and a ColorPalette (see Figure 6). The set provides a series of ready-made standard modules that look and behave consistently the same in every VB-DOS program.

PROJLIB.BI

This is my own library that includes these global variables whose list order must be the same as in projlib.lib. By example these comprise:

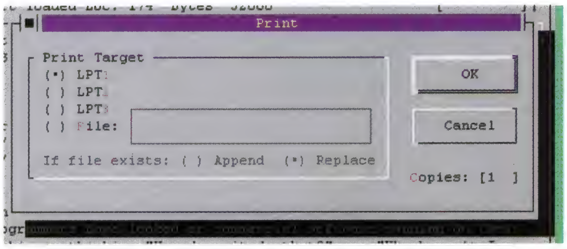
Adaptor$	contains the video adaptor name deduced by Video.Hardware function at start-up RESERVED
DirLoadFlag	determines whether program was loaded by a standard DeskTop frontend RESERVED True – was run by DeskTop (CHAIN command). False – was not run by DeskTop, but from DOS command level.
FileSpec$	globally accessible storage for default filename and path, general-purpose NOT
HelpName$	name and path of help file for the program NOT RESERVED
Main.ForeColor	set at start-up and returned by Color window RESERVED
Main.BackColor	set at start-up and returned by Color window RESERVED



File Name: TRI_BITS.TXT

C:\AMIPRO\DOCS

Figure 3. File I/O dialogue as a modal secondary pop-up window.

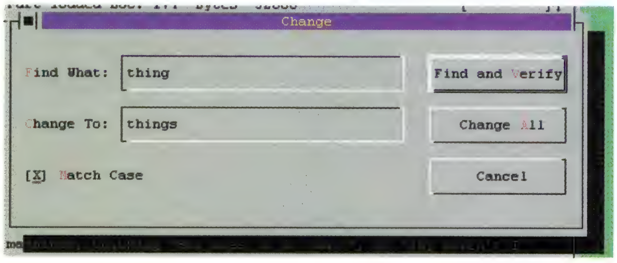


(•) LPT1

If file exists: ( ) Append (•) Replace

Copies: [1]

Figure 4. Print dialogue window with the option to print to file.



Find What: thing

Change To: things

[X] Match Case

Figure 5. Find/replace dialogue. Functionality has a very close similarity to Windows' common dialogue version.

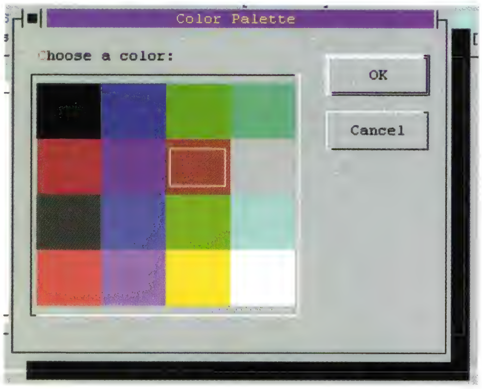


Figure 6. Common Dialog Toolkit colour palette. These are the 16 in total colour hues that VB-DOS uses. These colours can be applied to common component parts of all forms; border, background, menus, etc.

These variables are accessible across all modules and provide a simple way of communicating data between forms and procedures.

Modules and Procedures

VB-DOS uses two kinds of modules, forms and code. The principle id virtually identical to VB for Windows, with a few quirks. Form (.FRM) modules contain data declarations, event procedures, and general procedures. In addition, form modules contain the objects and properties of a form. Code (.BAS) modules contain data declarations and globally accessible procedures.

Event procedures in a form module should be written only for those events to which you want a form or control to respond. Just as VB for Windows, VB-DOS provides several keywords used specifically to write code for modules and procedures.

Variables can be either shared by form or code modules using the COMMON SHARED statement (required alternative to the Global keyword), or passed to procedures by reference or by value (BYVAL, see below).

A new module is created when you choose either 'New Form' or New Module from the 'File' menu of the VB-DOS code editing environment. 'New Module' adds a code module (.BAS). 'New Form' adds a form module (.FRM), causes a jump to the Form Designer (as does the 'Form' button in the VB-DOS code editor. This form designer is shown in Figure 7. It is not too unlike the VB for Windows equivalent, if somewhat less refined.

Form modules are private, where event and general procedures within form modules cannot be called from external modules or procedures. Executable code is not allowed at the module level of a form module.

However, code modules are public; general procedures contained within code modules can be called from other modules or procedures. Executable code is allowed at the module level, and apart from this it can be proved that in these respects VB-DOS is not very different from VB for Windows.

Subs, Functions, and Procedures

The following keywords are used in VB-DOS to declare SUB and FUNCTION statements, pass parameters, and transfer control to programs:

Like VB for Windows:

ANY	Disables type checking in AS clause of DECLARE statement
BYVAL	Passes variable by value rather than by reference
CALL	Transfers control to VB-DOS SUB procedure
EXIT	Immediately exits SUB, FUNCTION, DO, FOR, or DEF FN (VB for Windows does not have DEF FN)
FUNCTION	Declares name, parameters, and return type of FUNCTION
SUB	Declares the name and the parameters of SUB

Unlike VB for Windows:

CHAIN	Transfers control specifically to another VB-DOS program
DECLARE	Declares VB-DOS SUB or FUNCTION procedure. Unlike VB for Windows, all must be declared before they are accessible even within the same module
RUN	Restarts program in memory or executes another
STATIC	Makes a variable local to a procedure and preserves its value

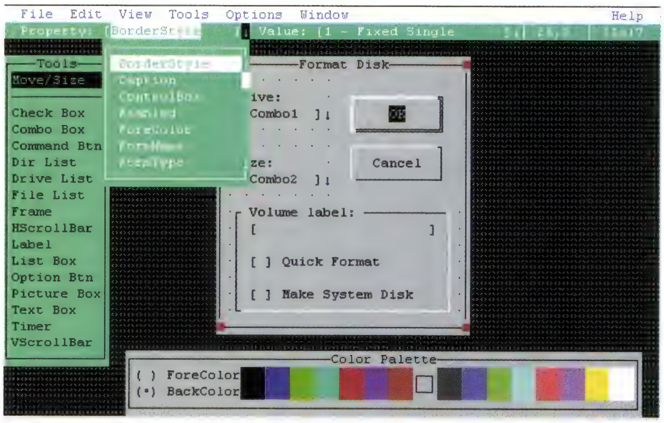
Passing an argument to a procedure 'by reference' means that the procedure is given the address of the argument. This allows a procedure to change the argument's value in the calling procedure. Whereas passing an argument 'by value' means that the procedure is only given the value of the argument. This allows the argument to change locally in the procedure without affecting the variable in the calling procedure.

Designing Forms

With VB-DOS, forms are created in the Form Designer (FD.EXE, see Figure 7). This is a separate utility used to build the user interface (forms and controls) for the application, and it can be started from the DOS command line.

Forms can also be dialogue boxes in VB-DOS. The BorderStyle property settings identify a form as either a window or a dialogue box. You can even have borderless and titlebar-less windows. Menus can be made in exactly the same way as VB for Windows.

Every VB-DOS form will also have a control menu in which you can minimise, maximise, close, etc. Unlike VB for Windows, disabled options remain as disabled entries in the menu, not removed, see Figure 8.



Property: BorderStyle

Value: 1 - Fixed Single

Figure 7. The VB-DOS Form Designer is not too dissimilar to VB for Windows.

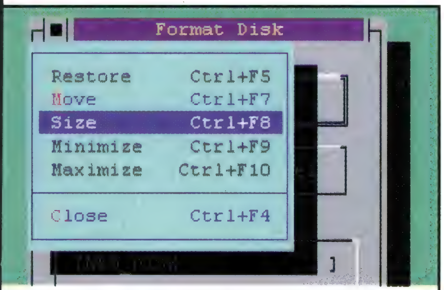


Figure 8. All VB-DOS forms share this common control menu layout. Only accessible if the 'ControlBox' property is true.

This also shows how the 'accelerator keys' (highlighted short-cut letters) in VB_DOS menus are shown in a different colour but only if the selection is enabled.

Moreover, it is even possible to create a Multiple Document Interface (MDI) application in VB-DOS having several child windows, in which the MDI parent contains the menu bar of the child with focus in addition to its own menus.

These are the same basic controls provided by VB for Windows, hence form modules using these only are relocatable from one environment to the other. The exception is the picture control, which of course cannot show actual pictures in DOS. However, it can be the background parent to a group of controls, and provides an area where the PRINT statement can be used.

Figure 9 shows one example of a utility window I created, based on Windows' own disk format utility, using a selection of these standard controls, including a frame as a group parent. The module works by shelling to DOS, writing a complete disk format command string that includes the selected options.

Globally Accessible Routines In PROJLIB

```
DECLARE SUB DateTime (File$,
FileSize&, FileAttribute$, YR%,
MNTH%, DY%, HRS%, MINS%, SECS%,
Mode%)
```

Uses DOS interrupts to read/write a disk file's date/time stamp.

```
DECLARE FUNCTION DiskSpace (BYVAL
Drive AS STRING) AS DOUBLE
```

Uses a DOS interrupt to return free disk space.

```
DECLARE FUNCTION EXTRACT (BYVAL
MainStr$, MatchStr$) AS STRING
```

Same as the VB for Windows equivalent, see Part 2 of this series.

```
DECLARE FUNCTION FileCopy
(Source$, Destination$, ErrCode
AS INTEGER) AS INTEGER
```

Copies a disk file from one place to another, also transferring the DOS date/time stamp. The actual copying is done in binary file access mode as a series of raw data blocks, so it copies anything.

```
DECLARE FUNCTION FileExists
(FSpec$) AS INTEGER
```

Same as the VB for Windows equivalent, see Part 2 of this series, but uses a DOS interrupt.

```
DECLARE FUNCTION InstrAny (BYVAL
MainStr$, MatchStr$) AS INTEGER
     DECLARE FUNCTION PadLeft
(BYVAL MainStr AS STRING, Target
AS INTEGER) AS STRING
     DECLARE FUNCTION PadRight
(BYVAL MainStr AS STRING, Target
AS INTEGER) AS STRING
     DECLARE FUNCTION REMOVE
(BYVAL MainStr$, MatchStr$) AS
STRING
     DECLARE FUNCTION REPLACE
(BYVAL MainStr$, MatchStr$,
RepStr$) AS STRING
```

All above same as the VB for Windows equivalent, see Part 2 of this series.

```
DECLARE FUNCTION GetFileSize
(File$) AS LONG
```

Uses the file pointer DOS interrupt to return file size.

```
DECLARE FUNCTION GetFileAttr
(File$) AS STRING
```

Duplicates the VB for Windows FileAttr function.

```
DECLARE FUNCTION GetFileDateTime%
(File$, DATE.BIN&, TIME.BIN&)
     DECLARE FUNCTION
SetFileDateTime% (File$,
DATE.BIN&, TIME.BIN&)
```

Both low-level functions using DOS interrupts for fetching/writing the DOS date/time stamp of a disk file in its basic long integer form (not dismantled into year, month, day, etc.)

```
DECLARE FUNCTION Corrected (BYVAL
Path$) AS STRING
```

Same as the VB for Windows equivalent, see Part 2 of this series.

```
DECLARE FUNCTION VIDEO.HARDWARE
() AS DOUBLE
```

VB-DOS specific. Called at start-up of an application to find out the base address of the video memory. If this turns out to be for monochrome only, then a following IF statement suppresses the fetching of the COLORS.INI data for initialising system colours.

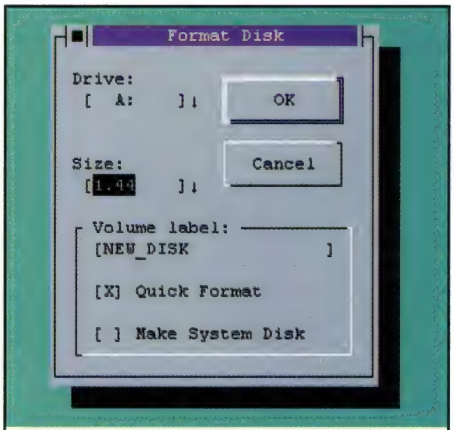
And Lastly

Supposing you actually get around to having anything much to do with VB-DOS, here is an important message: all common shared variables must be duplicated exactly if declared in more than one root section of a BAS module (for a linked library also). If you create a new global variable, it must be added to all other instances of the list in the other modules, and in the same sequence!

Failure to follow this protocol will eventually result in a program with massive problems, keeps crashing, etc. The COMMON SHARED variable list must be duplicated exactly at the module level of all forms which use any one of these variables. Also, COMMON SHARED dimensioned arrays will not communicate across modules, unlike the case for VB for Windows.

If you can find a use for this library set for VB-DOS (version 1), please apply privately to the author, P.O. Box 5773, Laindon, Essex SS15 5FJ. Maplin Electronics plc and its associates cannot be held responsible for the accuracy or reliability or otherwise of such information or utilities.

Next month we will look at how to use and avoid the pitfalls associated with Microsoft Access and dBase IV, plus how to create installation and setup procedures.



Drive:
[A:]↓

Size:
[1.44]↓

Volume label:
[NEW_DISK]

[X] Quick Format

[ ] Make System Disk

Figure 9. An example custom made tool dialogue showing a number of standard controls directly transferable to or from Visual Basic for Windows.

The following controls are available in VB-DOS:

Check Box	Toggles the selection of an option on and off
Combo Box	Allows a user to enter text or select from a list
Command Button	Performs an action when chosen
Directory List Box	Enables the selection of directory path
Drive List Box	Enables the selection of disk drive
File List Box	Enables the selection of file(s)
Frame	Provides a functional grouping for controls
Horizontal Scroll Bar	Allows selection from a range of values
Label	Displays text that the user cannot change
List Box	Allows the user to select from a list
Menu	Displays items the user can choose from
Option Button	Permits the selection of one item in a group
Picture Box	Displays ASCII characters on a form
Text Box	Displays text that the user can change
Timer	Specifies a time interval for timer events
Vertical Scroll Bar	Allows selection from a range of values

VB-DOS Controls Summary.

RESEARCH NEWS

3-Dimensional Laser Sculpturing for Industrial Manufacturing

Researchers at the Fraunhofer Institute in Dresden, Germany have developed a novel way to produce internal 3-dimensional (3-D) sculpturing of glass for any appropriate transparent medium by the use of sub-surface laser engraving. Images of real 3-dimensional objects, such as a picture of the Earth, may be faithfully reproduced within a volume of optically transparent lead crystal glass as shown in figure 1. The technique was developed by Dr Andreas Lenk and co-workers in the Dresden Institute, and has potential applications in a variety of areas including 3-D displays and product marking.

Historically, lead crystal has been engraved by laborious methods such as grinding, cutting and sandblasting. Unfortunately, these traditional skills require time consuming 'manual' labour. In addition, the severe problems of 'writing' detailed fine-scale structures onto the glass, and in more recent times the concerns for the environmental impacts caused by toxic chemical waste from grinding etc. entering the food chain, must be considered. To overcome these 'commercial problems,' the Fraunhofer Institut Werkstoff- und Strahltechnik (Fraunhofer IWS) in Dresden and Peill-Kristall Barenhutte GmbH Weibwasser has jointly developed a laser technique for sub-surface engraving of lead crystal. Dr Lenk's method also creates a highly novel decorative art form; a 3-D image created within the lead block, caused by the extraordinarily precisely focused laser beam. Amazingly, there is no observable effect on the outside polished glass surface where the laser energy is relatively defocused.

Laser technology

Within a normally transparent material, a high intensity focused laser beam will create a significant non-linear optical absorption phenomenon. As a consequence, small microscopic cracks are generated from thermal heating of the glass within a tightly constrained volume. The spots appear white under reflected 'day-time' white light illumination. The power densities required to achieve their results are in the range 10^{10} to 10^{12} Wcm^{-2}, equivalent to a 100W light bulb concentrating all of its output power across an area typically less than one micron square! This is a tremendous feat of optical engineering skill, and the output beam is generated using a specially designed Neodymium/Yttrium Aluminium Fluoride crystal laser (more commonly referred to as a YLF laser). It is hardly surprising, with these high laser intensities, that cracking of the glass on a micron scale, typically 100 microns across, will occur.

Dr Lenk believes that this is the first practical application of the Nd/YLF class of laser for the optical tooling of transparent materials anywhere in the world, and may lead to a highly specialised market for sub-surface material structuring on a micron to sub-micron scale.

The images are created pixel by pixel within the substrate glass. The substrate sheet glass or lead crystal 'object' is moved in either 2- or 3-dimensions with computer controlled positioning and real-time position data acquisition. A Continuous-Wave (CW) laser operates with repetition rates of up to 500Hz. Each 3-D glass 'picture' may contain up to 10,000 dots created by using laser pulses typically of 60 nanoseconds (ns) duration with a pulse repetition interval (time between pulses) of 13ns at an output emission wavelength of 1.05μm, just beyond the visible region of the electromagnetic spectrum in the near infra-red. Each laser pulse results in one pixel. Pixel spacing is crucial, fo if they are too close together cracks may join up to produce a major stress fault which could lead to the glass fracturing. To avoid this problem, the existing microcrack sample points, which are about 100μm across, are spaced some 250μm apart. The maximum area for 2-D sub-surface engraving is 50 × 50mm square (with imminent plans fo 100 × 100mm square). Because of the typical point to point distance of 250μm, this area is related to an array of 200 × 200 pixels. The maximum volume fo full 3-D sub-surface engraving is $(45 \times 45 \times 55)\text{mm}^3$.

Q-switching the laser may produce laser etching pulses up to 300ns in duration with peak powers in excess of 2MW. Q-switching is a concept worth discussing in a little detail. Consider a cavity laser and then introduce a huge loss into the cavity, for example if one of the mirrors at the end of the laser cavity was covered up in some way. Normally this would be a disaster as it would prevent the laser from operating. However, it also means that the population inversion in the laser medium may rise to well

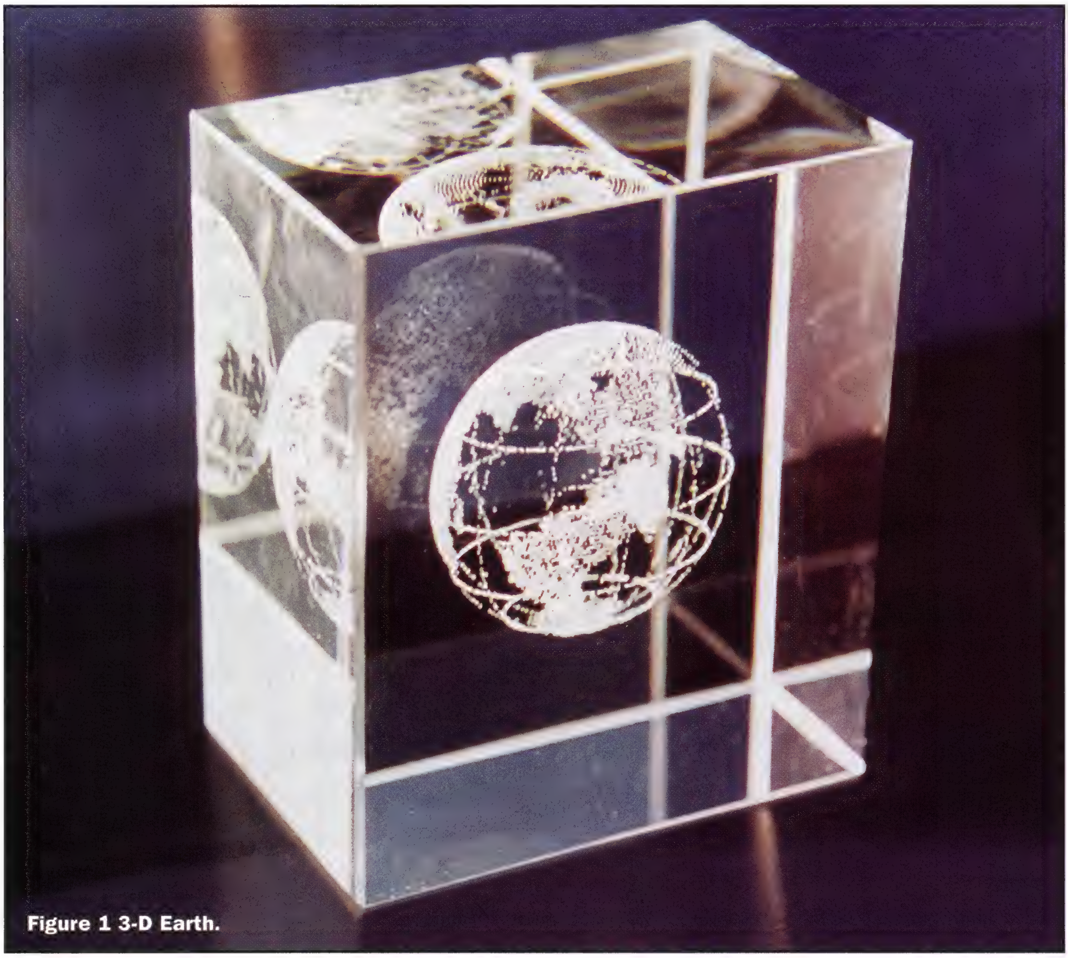


Figure 1 3-D Earth.

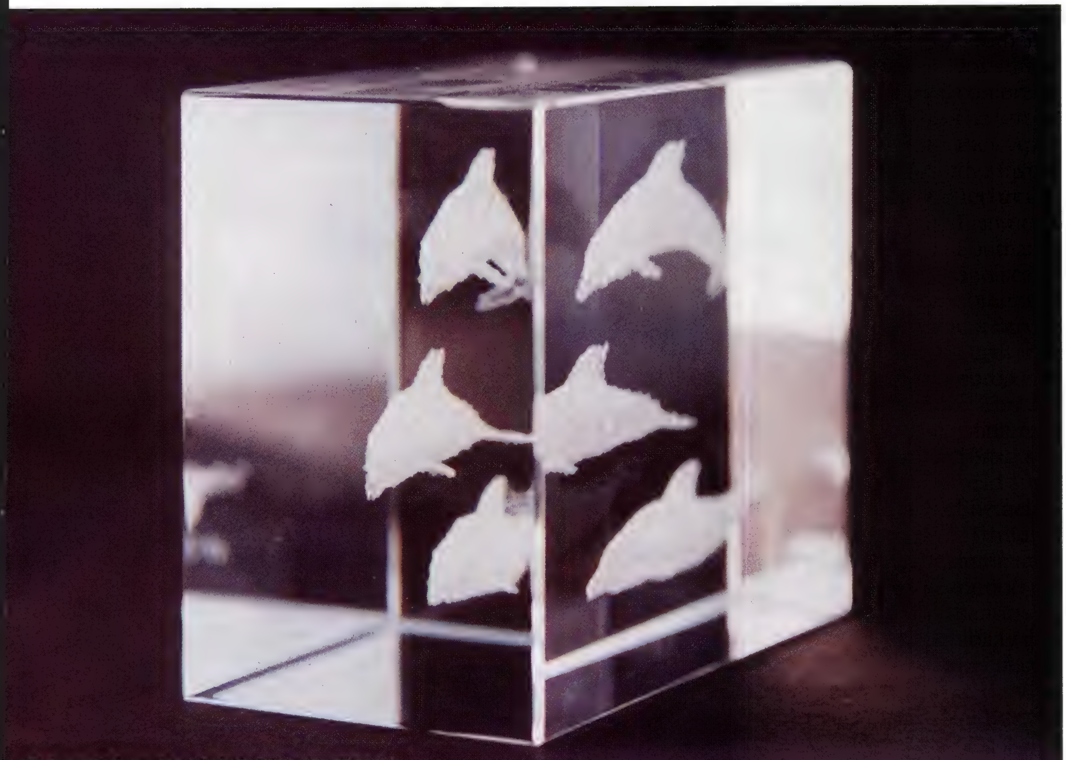


Figure 2 Image of dolphins in glass.

above its normal value. If the loss is suddenly reduced back to its normal value, the signal gain will be much larger than the normal running or threshold gain. The result is a very rapid increase in photon density inside the cavity, leading in turn to a rapid reduction in the population inversion through stimulated emission, generating a high-power laser output. A short intense pulse is emitted by the laser and this is called Q-switching. The name originated historically because of the association of cavity loss with a Q value (a high loss being associated with a low Q value). The sudden change in the cavity loss implied a sudden change (or switch) in the Q value.

The optical image generating process works with expensive optical quality glass, readily available cheap float glass which has reduced optical quality, and indeed other kinds of glass. It could be used as a highly effective way to impose security markings deep within the glass (at least 5mm below the surface), which cannot be scratched away by a thief trying to disguise the true ownership of a high unit cost item, e.g. name or logo on a BMW or Rolls-Royce car window!

Further possibilities for this class of technology may be conceived, such as the use of a sensitive rewritable optically transparent polymer to hold a 3-D real time moving image. If the number of pixel elements was increased to support a sufficiently large image it could pose a rival monochrome threat to current proposed holographic TV and 'free-space' 3-D holographic images. There are considerable developmental problems to be overcome before a cheap 'optically safe' 3-D TV will become a reality for the majority rather than an unaffordable dream. Perhaps a transparent optical cube may become a common place item in future households! No matter what evolves on the image display front, the technique of sub-surface laser engraving demonstrates both technical excellence and a new beautiful transparent 3-D artform, (to be seen in figure 2 as the image of dolphins in glass).

Further Information:

Dr A Lenk E-mail
lenk@iws.fgh.de
Internet http://www.iws.fgh.de/
Pictures courtesy
of Dr Andreas Lenk.

Forthcoming Important Electronics and Optoelectronics Conferences

The 24th International Conference on the Physics of Semiconductors is to be held in Jerusalem, Israel between 2nd-7th August. This conference marks two anniversaries; the creation of the modern state of Israel 50 years ago, and the discovery of the transistor in the same year. Plenary lecturers will cover topics such as quantum computers, the development of the transistor, and quantum wires and dots. Contributions are invited in 10 different topic areas.

Eurosensors XII will be held in the Bolderwood Conference Suite of the University of Southampton, UK between 13th-16th September 1998. This conference also incorporates the 9th of the 'Sensors and their Applications' series run by the Instrument Science and Technology Group of the Institute of Physics. Southampton is a historic city and seaport surrounded by some of the most beautiful countryside and cities in Britain. Further information: e-mail eurosens@ecs.soton.ac.uk

The 2nd European Conference on Magnetic Sensors and Actuators is to be held at the University of Sheffield, UK between 13th-15th July 1998. We live in an interesting developmental period for magnetic based sensors and actuators. Their ability to generate a wide range of effects such as signals, forces and motions has become indispensable for many devices and systems. This conference reflects an innovative and important area for the applied science of magnetism.

Further Information:

http://www.shef.ac.uk/~phys/emsa98 html
E-mail:
icps24@physics.technion.ac.il

TO ADVERTISE IN
ELECTRONICS
and Beyond

Telephone
Donald Train
at Fox Publishing
0181 869 8410

Back to the FUTURE

The semiconductor industry is about to hit a brick wall. Using current techniques it is not possible to make the components on integrated circuits much smaller and consequently the limits of integration are within sight. The saving grace will be new materials and manufacturing techniques. Here Stephen Waddington explores some of the options.

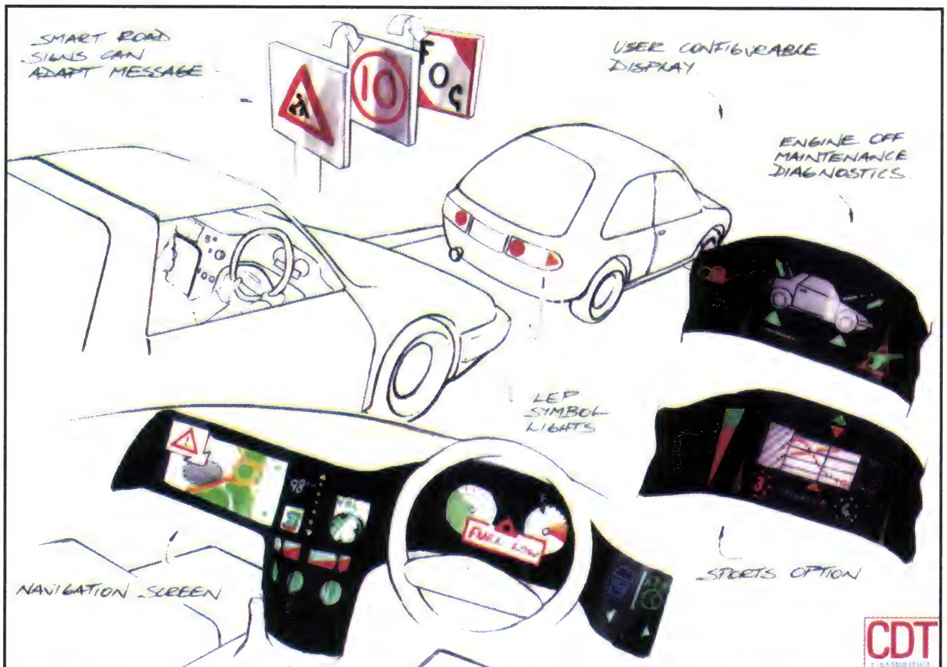

SMART ROAD SIGNS CAN ADAPT MESSAGE
10
0°C
USER CONFIGURABLE DISPLAY
ENGINE OFF MAINTENANCE DIAGNOSTICS
LEP SYMBOL LIGHTS
FUEL LOW
SPORTS OPTION
NAVIGATION SCREEN
CDT

Photo 1. Cambridge Display Technology wants to transform the car dashboard into a single display with its light emitting polymer (LEP) technology.

Convergence was the buzzword of the CeBIT annual European technology trade show, which took place in Hanover early this year. The collision of the Internet, telecommunications and computing is resulting in some incredible products.

Trimble Navigation, developers of the global-positioning satellite (GPS) systems are chasing the goal of the GPS on a watch. GPS systems include an RF front end that incorporates inductors for tuning the receiver and radio frequency (RF) amplifier and for bandpass filtering, and a digital chip that carries out logic, memory and all other functions.

The desire to develop convergent products is apparent across all electronics sectors. A product concept from Swedish wireless handset manufacturer Ericsson combines a cell phone, modem and QWERTY keyboard. The keyboard would pull out to the side and the user could access the Web remotely. It would also have limited built-in capabilities for spreadsheets and other functions.

Meanwhile Cambridge Display Technology (CDT) wants to turn the conventional car dashboard into a screen as shown in Photo 1, using its light emitting polymer (LEP) display technology. Here conventional analogue dials, mileage-counter and indicators would be replaced with patterned graphical equivalents, with the added bonus that there would be no need for backlighting, as polymer displays are self-emissive.

Keeping up the Pace

But if these products are to become a reality it will require a single integrated circuit consisting of more than 10 million transistors that combines memory, radio frequency, microprocessing and control. Trimble Navigation needs to integrate microprocessor, RF, logic and memory on a single device, while CDT's LEP dashboard screen will require complex driver circuitry. Today's semiconductor processing technologies simply cannot hack the pace of integration.

Manufacturing techniques have scaled over the last two decades from gate dimensions of 20mm to the latest geometry of 0.35mm – a micron is over 100 times thinner than a human hair. Naturally there is a significant increase in the number of components that can be housed on a single device with every reduction in physical process geometry.

The end of the tunnel is in sight. With the latest wave of integrated circuits, we are very close to reaching the physical limitations of the manufacturing process. It is not possible to go much smaller using current materials – and consequently it is unlikely that we will see devices consisting of much more than the 10,000,000 transistors typical of the latest crop of microprocessors.

Ultimately the issue of scaling much beyond current geometry lies in the physical interconnections made between the individual gates on a piece of silicon. Once the raw electronic components have been fabricated in the silicon, thin aluminium and doped poly-silicon films are added to form the interconnections among

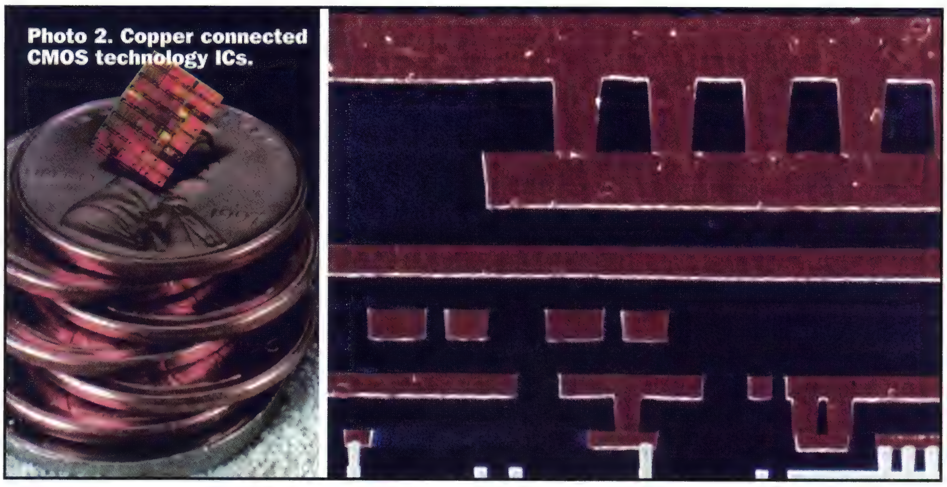


Photo 2. Copper connected CMOS technology ICs.

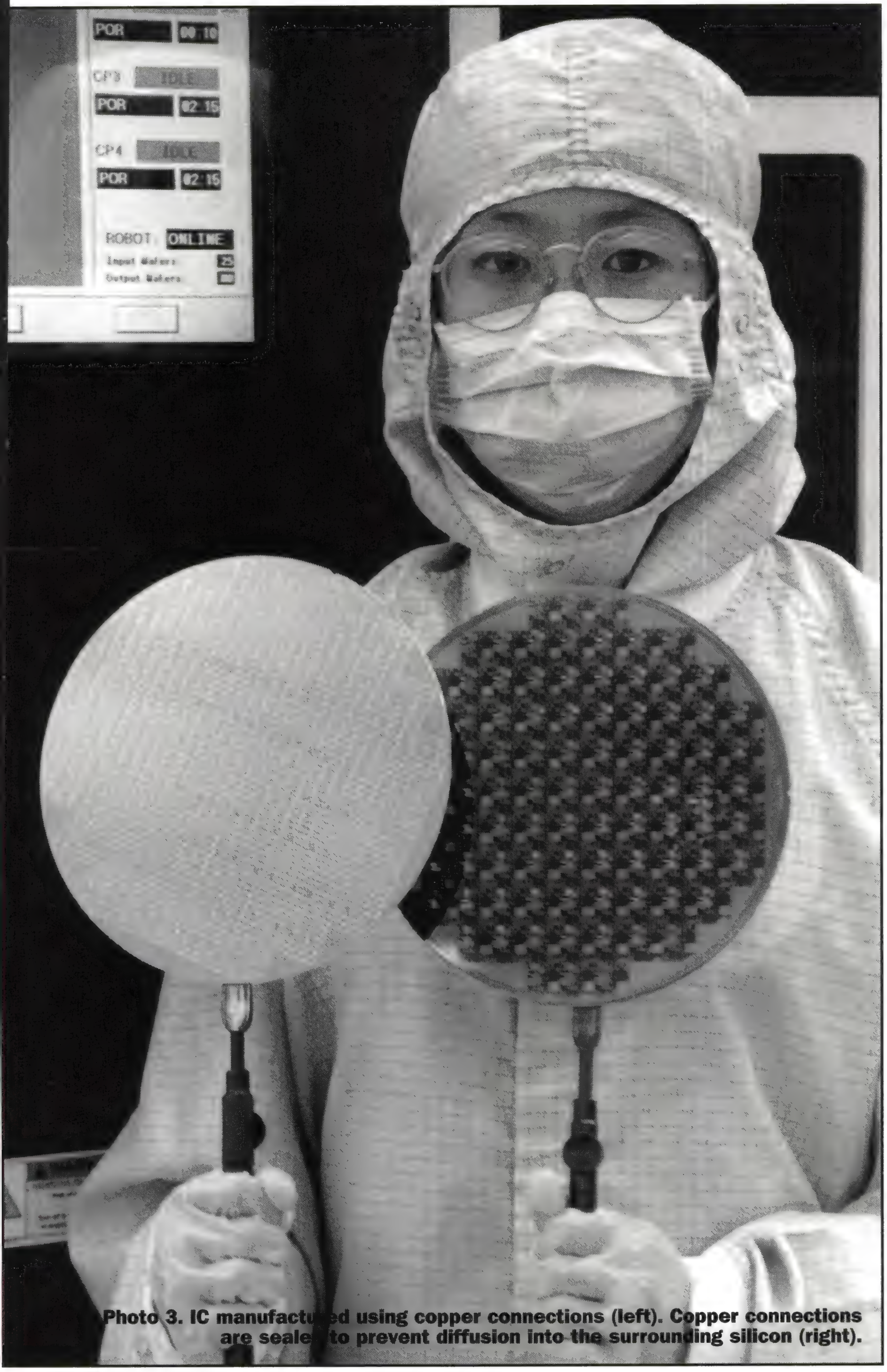


Photo 3. IC manufactured using copper connections (left). Copper connections are sealed to prevent diffusion into the surrounding silicon (right).

individual transistors and other devices. On some chips, there may be up to six layers of these minute interconnecting wires joining together millions of individual circuits.

It is the aluminium interconnects that are the weakness. Aluminium is traditionally used because it has good electrical characteristics and is reasonable easy to manipulate in the manufacturing process. But aluminium's high resistivity at the line widths required for the coming 0.25mm generation of ICs will impose significant signal delays.

Moore's Law Extension

In the early eighties, Intel co-founder Gordon Moore claimed that chip performance would double every 18 months. While this broad rule has held true so far, if its to remain accurate into the next century, manufacturers are going to have to find new materials and manufacturing processes.

The solution is to replace the aluminium interconnects with a more robust material that has superior electrical properties. Copper is currently the metal mooted by electrical engineers as the solution.

The work has been carried out for a number of years by researchers in academia and industry, but urgency was added late last year after announcements by IBM, Motorola, Texas Instruments and others involving breakthroughs in the use of lower-resistance copper.

Copper diffuses readily into silicon, but barrier materials have been developed to reliably seal it off. Unlike aluminium, copper interconnects must be sheathed with a thin barrier metal to avoid corroding the silicon substrate. This is the key reason that aluminium has traditionally been used for integrated circuit interconnects, and why semiconductor manufacturers are approaching the possible switch from aluminium to copper with a high degree of caution.

The requirement to prevent corrosion of the silicon wafer is not the only reason that the copper interconnects need to be insulated. As the metal lines get closer together, the problem of signal interference, or crosstalk, within the integrated circuit increases.

Copper Chips

Sematech, a non-profiting making research and development consortium of semiconductor manufacturers, claims to have identified suitable insulating materials to shield the copper interconnects. For competitive reasons, Sematech researchers are reluctant to identify the insulating material and other materials involved in the ongoing research, suffice to say the insulating material has a dielectric constant of 2.7. Photo 3 shows a Sematech researcher with a silicon wafer containing copper interconnected integrated circuits.

IBM claim to be ahead of Sematech. In September, the company announced that it would soon start full-scale manufacture of chips that use copper. New copper interconnects will be implemented initially in IBM's complementary-metal-oxide-semiconductor (CMOS) technology. The CMOS 7S process, as it is known, integrates six metal levels, a 0.2mm drawn gate and a 0.12mm effective channel length.

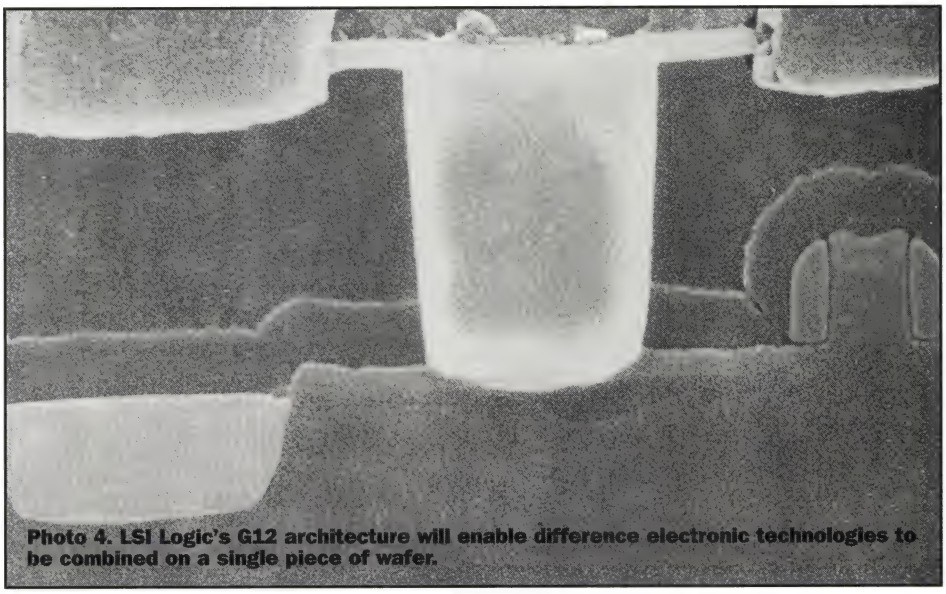


Photo 4. LSI Logic's G12 architecture will enable difference electronic technologies to be combined on a single piece of wafer.

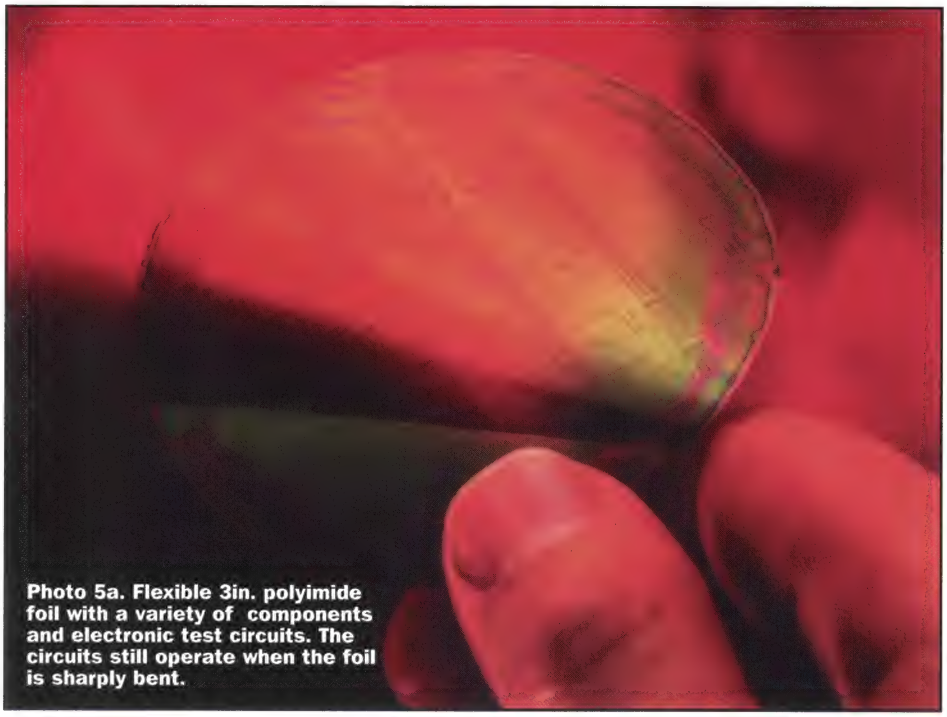


Photo 5a. Flexible 3in. polyimide foil with a variety of components and electronic test circuits. The circuits still operate when the foil is sharply bent.

The CMOS 7S process offers up to 200,000,000 transistors, 12,000,000 gates and 2,200 multiplexed inputs and outputs (I/O) on a single chip as shown in Photo 2. The transistors operate at 1.8V, while 2.5V is required to drive the I/O. Early applications are expected to show up in products as chips for mainframes and the PowerPC chips used in IBM's RS/6000 and AS/400 computers.

Eventually IBM expects to use CMOS 7S in all its systems. Similarly, copper itself will become more widespread in the semiconductor industry. "In time, everybody will be making copper chips," said John Heidenreich, manager of interconnect technology at the IBM Thomas Watson Research Centre, who has overseen work on copper since May 1994.

Heidenreich cites several compelling reasons for that projection. Copper wires conduct electricity with about 40% less resistance than aluminium. That translates into a speedup of as much as 15% in microprocessors that contain copper wires. Copper wires are also far less vulnerable than those made of aluminium to electromigration, the movement of individual atoms through a wire, caused by high electric currents, which creates voids and ultimately breaks the wires.

Component Architecture

But producing integrated circuits with a denser component count is only part of the solution for electronic product designers that want to build single chip products. One of the other major stumbling blocks is combining difference types of electronic circuit on a single piece of silicon. A single chip system for use in products such as mobile telephones and digital cameras has been a Holy Grail for the electronics industry for more than two decades.

March saw LSI Logic announce G12; a solution it claims is the next evolution of architecture for single-chip systems. Unlike any other chip technology, G12 will enable engineers to combine RF, memory, logic, Intellectual Property (IP) cores and microprocessor engines on a single piece of silicon to create a 'true' single chip solution – competitive architectures have so far failed to combine different technologies. LSI Logic claims that G12 technology is able to provide 26,000,000 logic gates, or 223,000,000 transistors on a tiny 20mm square silicon chip.

The G12 architecture show in Photo 4, is 40% faster than the previous generation technology, and it also cuts power consumption in half while increasing the logic density by three times. The G12 product offers designers, for the first time, the opportunity to optimise a design from the transistor level upward for the end application. This mapping of silicon technology to end applications, historically, has only occurred at the high performance end of the market. Now, with G12 this deep level of differentiation occurs for applications ranging from cellular phones to supercomputers.

The level of differentiation within the one G12 product is achieved through the use of two different transistors. One optimised for low leakage at 1V and one for high performance at 1.8V. The end product optimisation is further achieved through the design of the cell libraries, design tools and methodology, industry standard cores and Intellectual Property (IP), and focused packaging. The product's flexibility is derived from the ability to mix high performance and low leakage transistor cell elements on one die, as well as supporting both 1.8V and 1V operation. Again on a single die if required. For the first time, this allows extremely market-focused products from the silicon upwards.

The effective channel length of the transistor developed for the G12 CMOS technology is 0.13mm. The architecture has been engineered to allow two transistors to be manufactured on the same process flow and on the same die if necessary. One transistor has been designed for extremely high performance at 1.8V, the other for slightly lower performance but very low sub-threshold leakage at 1.8V and 1V. By incorporating these two transistors onto one process, the dilemma of how to provide high performance and low leakage on one process flow has been overcome.

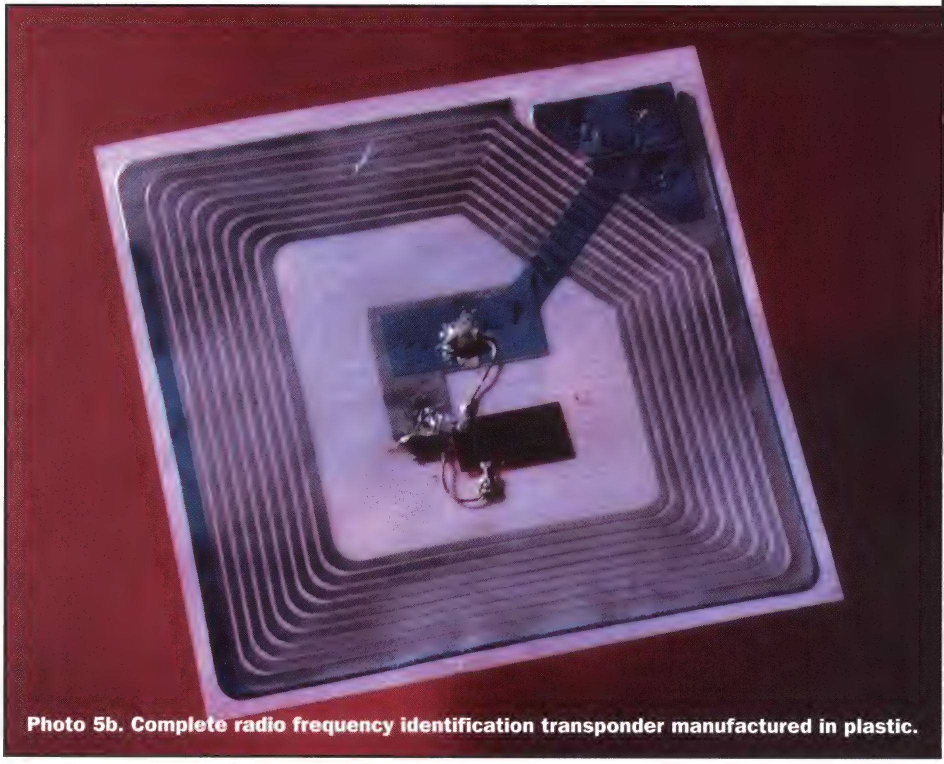


Photo 5b. Complete radio frequency identification transponder manufactured in plastic.

The electronic design process market always demands a higher level of performance from the silicon. By optimising one transistor for fast switching and high drive currents at the expense of leakage, the fundamental requirement of this market has been met. The high-performance G12 transistor is 40% faster than the previous generation transistor and can on average drive 20% more current even though the previous generation operates at 2.5V and the G12 transistors operate at 1.8V.

At the other end of the spectrum, battery powered devices such as mobile phones, require high standby times. The process technology is a factor in this equation, since

Photo 6. Polymer display from Cambridge Display Technology (CDT), announced in February this year.

the sub-threshold leakage of the transistors contribute directly to the off current of the circuit. This off current draws charge from the battery when the device is in standby mode by reducing the sub-threshold leakage by a factor of two from the previous generation technology, while still increasing performance. The G12 process is ideally suited to being a foundation for designs targeted for battery powered applications.

The transistor packing density achieved on the G12 process is roughly three times that achieved in the previous generation technology. This has been made possible by a number of factors. These are a reduction in effective and drawn transistor gate lengths and the inclusion of shallow trench isolation. In previous technology generations, the isolation between two adjacent transistors has been achieved through a recessed LOCOS (local oxidation of silicon) structure. By replacing this structure in G12 with a shallow trench, the adjacent transistors can be situated closer to each other while still maintaining an effective isolation barrier. Since the shallow trench forming the isolation has a flat topography, this creates a more planar surface than was previously possible with LOCOS isolation.

Plastic Fantastic

But a novel chip-level architecture is by no means the only solution in the quest for superior integration and denser component count. Conjugated polymers promise fundamental advances. Researchers at Philips Semiconductors have fabricated field effect transistors using a potentially low cost all-polymer technology. These integrated circuits are made on flexible substrates and still operate when they are sharply bent.

Philips used a technique based broadly on photographic etching principles called 'photochemical patterning' in order to fabricate its polymer integrated circuits. Here a cocktail of liquid polymers is coated onto a plastic substrate and allowed to harden. The polymer sheet is then exposed to ultra violet light via a mask. Exposed areas become non-conducting leaving a matrix of conducting tracks. The thickness of the resultant film is typically 0.2mm.

Within the polymer sheet, the conducting tracks are used as interconnects and electrodes of the polymer device. Because of the relative simplicity of the manufacturing process, Philips believes that while the technology will not necessarily offer the scale of integration of traditional semiconductor devices, it will lead to low cost consumer products where a robust, flexible technology is required. See Figure 5a.

Active Plastic

Philips has already demonstrated a complete radio frequency identification transponder, which combines both a LC resonant circuit and a programmable code generator on a single piece of plastic as shown in Photo 5b.

Here the base station of a radio frequency identification system sends a signal to the transponder, which is picked up by the LC circuit. A diode is added to the LC circuit, thereby generating the supply voltage for the programmable code generator. The code generator periodically damps the LC resonance circuit in the pattern determined by the polymer code generator. This variable damping can is detected by the base station and thus the transponder code can be received.

The application of polymers as semiconducting devices is not new. Cambridge Display Technology (CDT) has been working on the development of light emitting polymers for display applications since 1992. The company announced a joint development with liquid crystal display manufacturer, Seiko-Epson in February this year, while also unveiling a tiny 50mm television display as shown in Photo 6.

Plastic Transistors

Meanwhile a team of researchers at Bell Labs, which is the research and development arm of Lucent Technologies, produced the first fully printed plastic transistor. Besides developing plastic transistors that are smaller and also more intricate in their design, the researchers have developed a new process that involves spraying liquids instead of printing. Because the spraying technique requires less material than printing, manufacturing costs would decrease even further, compared to making conventional silicon transistors.

Although it's unlikely that plastic transistors will ever replace the silicon variety, they would be very useful in certain high-volume applications. Besides computer screens and smart cards, other potential uses include luggage tags that help airport personnel locate lost suitcases, or tags on groceries that verify whether they were transported under the right conditions to the supermarket.

Plastic transistors can be disposable because of the inexpensive manufacturing process. In factories, for instance, machines deposit and etch all sorts of materials on silicon to make multi-layered transistors, which essentially are microscopic switches that form the guts of today's electronics. This process requires high temperatures, stringently controlled environments, and precision optics, all of which are very costly.

"We're interested in the most low-tech approaches," said chemist Howard Katz. After several years of development, Katz and his colleagues have created plastic

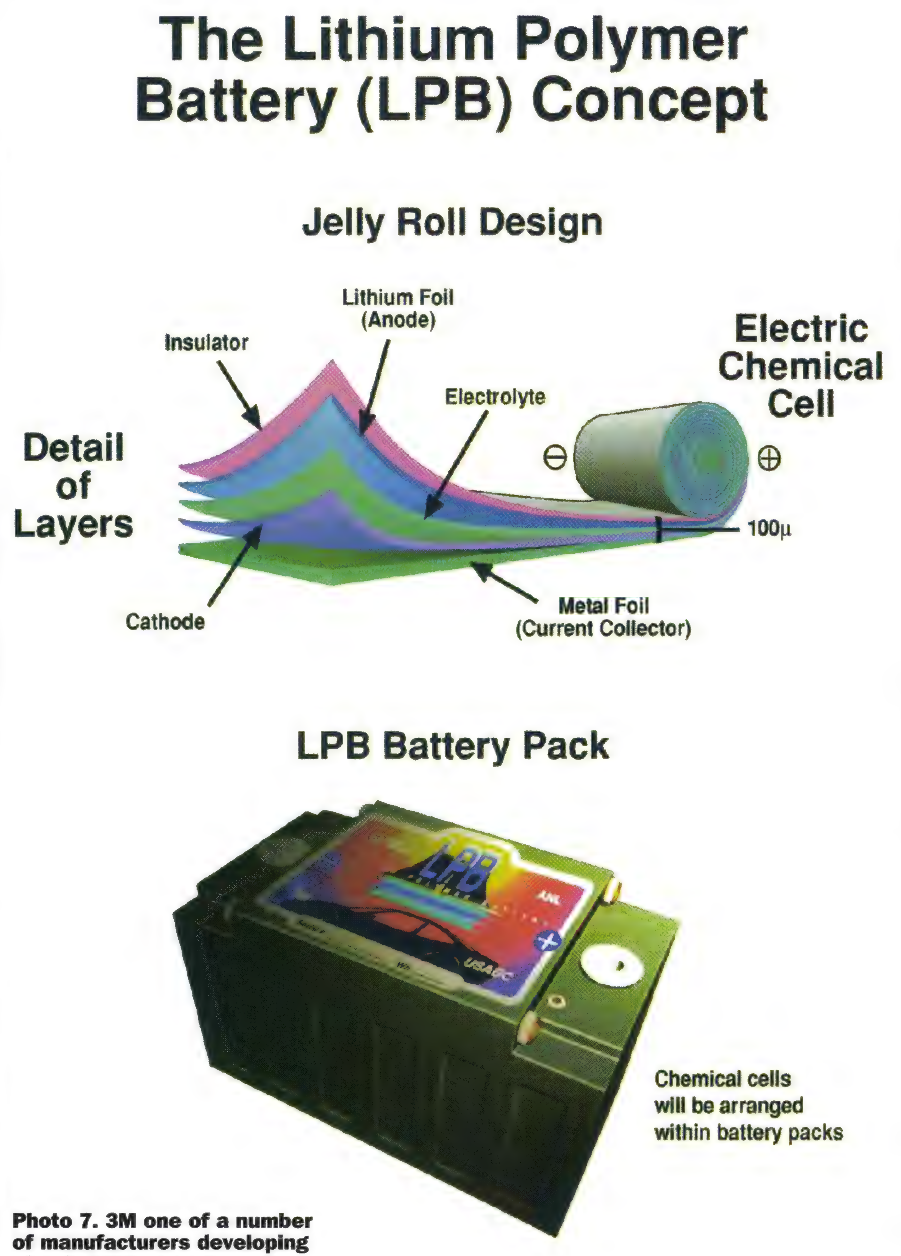


Photo 7. 3M one of a number of manufacturers developing plastic battery technology.

transistors in normal laboratory conditions. The major challenges have included developing materials with the necessary electrical characteristics, without sacrificing their flexibility and long-term reliability.

Using thin sheets of plastic – similar to overhead transparencies – as the base, the researchers print a transistor's multiple layers one layer at a time. They use a squeegee to apply a liquid plastic mixture over a stainless-steel mesh. After the solvent evaporates, the plastic remains. "The process is very similar to silk screening t-shirts," said chemist Zhenan Bao. The challenge is creating a liquid mixture with the correct viscosity. The mixture, for instance, must pass through the mesh, but it must be viscous enough so it will not spread too much on the surface.

Since the researchers introduced this liquid-based approach last year, they have been working to reduce the transistor's size, especially concentrating on the distance between the transistor's two top electrodes. As the distance decreases, the transistor's speed increases, and it also requires less power to operate. So far, the smallest distance achieved by the Bell Labs' scientists for the printed plastic transistor is 75mm.

"We're at the stage in plastic transistor technology where silicon was several decades ago," said chemical engineer V. Reddy Raju. The other three researchers on the Bell Labs' team are physicists Ananth Dodabalapur and Andrew Lovinger and chemist John Rogers. "Right now," continues Raju, "we're using inexpensive processes that produce larger features. Fortunately, there are some applications where size is not an issue. With a smart card, for example, people are happy with the size, but the plastic transistor would make it more flexible and durable than putting a silicon transistor on a card."

The most crucial building blocks for the plastic transistors are huge molecules that resemble spaghetti in terms of their molecular shapes. Ordering these molecules to achieve adequate transistor activity has been a considerable challenge. However, the spaghetti-like molecules are useful because they form continuous, flexible films. It may soon be possible to use much smaller molecules, which would be easier to purify and align than the longer molecules. As a result, the electrical properties would be easier to control, creating more precise switching within transistors.

"We found it's possible to make transistors by spraying dilute solutions of small molecules directly on a flat sheet," Katz said. "The droplets evaporate and leave behind the film that becomes the most crucial layer of the transistor. So far, the results have been similar to those achieved with the printing process."

Flexible Battery

One of the most interesting applications of polymer technology is in the area of batteries. 3M is currently working with the Advanced Battery Consortium (USABC) to develop Lithium Polymer Batteries (LPB) as shown in Photo 7. Compared to other battery technologies currently in use or under development, the LPB has the best combination of high specific energy and long cycle life – it has a expected specific energy of 200W-hours/kg and a cycle life comparable to the expected lead-acid cycle life.

3M has been investigating this technology since 1993 when it successfully showed the viability of thin-film lithium polymer batteries for use in electric vehicles. For electric vehicles to compete effectively with conventional internal combustion engines, the battery must allow vehicles to reach a range of 150 miles or more. Currently, lead-acid batteries produce approximately 35W-hours/kg, which allows electric vehicles to travel less than 100 miles per charge.

Final Word

The significance of new semiconductor manufacturing processes such as IBM's CMOS 7S, LSI Logic's G12 architecture and Lucent's polymer integrated circuits lies not just in the new capabilities it provides for semiconductor and electronics manufacturers, but in the advantages it holds for consumers who will ultimately benefit from the new products that result. Advances in miniaturisation allow for computer intelligence to be built into products that are smaller, integrate more complex functions, use less power and require less cooling. Devices such as mobile phones and personal digital assistants (PDAs), as well as computers, may become lighter and more powerful while untold new products may become possible for the first time. Who knows – we may even have a completely plastic, flexible computers before too long.

Further Reading

Cambridge Display Technology	www.cdtltd.co.uk
Ericsson	www.ericsson.com
IBM Microelectronics	www.ibm.com
LSI Logic	www.lsil.com
Lucent	www.lucent.com
Philips Semiconductors	www.philips.com
Sematech	www.sematech.org
Texas Instruments	www.ti.com
Trimble Navigation	www.trimble.com

Spreadsheets
FOR ENGINEERS & SCIENTISTS

PART 1

In the first of this two part article Mike Bedford gives an introduction to spreadsheets and investigates scientific functions.

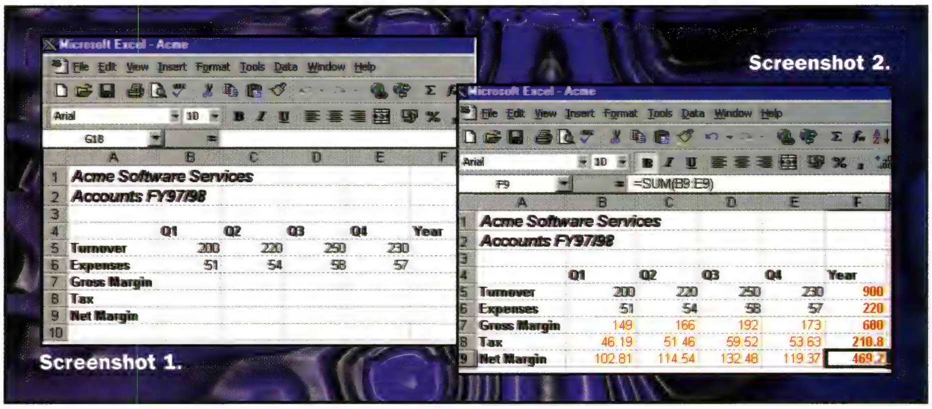
If you've bought a PC in the last year or so, it's quite likely that an entry level office suite was bundled with the hardware. Consisting typically, of a word processor, spreadsheet, rudimentary drawing package and perhaps publishing software and some other utilities. These suites offer the facilities required for most ordinary run-of-the-mill tasks, but let's face it, this sort of software isn't wildly exciting. OK, perhaps you use the word processor for writing letters and the spreadsheet for budgeting or home finances but this is probably as far as it goes. For scientific or technical applications – electronic design, for example – you'd need some much more specialised and expensive software. Well this, at least, is the conventional view of technically minded PC users. However, it's a view which I'd like to suggest is not entirely accurate. In particular, I'd like to suggest that the humble spreadsheet, rather than being a boring tool for accountants, is a package which provides many useful facilities for engineers and scientists. Furthermore, to use a spreadsheet requires much less programming expertise than, for example, writing a Basic program, and this solution is much less expensive than buying a dedicated mathematical package such as *MathCad*, *Maple* or *Mathematica.* In this article, we'll present a general tutorial on spreadsheets and go on to show how it can be used for mathematical or scientific applications. Although the screenshots and syntax all relate to Microsoft Excel, most spreadsheets operate in a similar manner with similar syntax so you should easily be able to adapt the principles to any other package.

Spreadsheet Basics

If you have already used a spreadsheet, even if only for fairly mundane applications, then you're probably not going to learn much from this first section so you may like to jump forward to where we start looking at scientific applications. If, on the other hand, the spreadsheet is the one part of your office suite which has, so far, remained untouched, then his section is for you. Because although this article is about scientific uses of a spreadsheet, a knowledge of the basics is an essential foundation.

So what is a spreadsheet? Intriguingly, it's one of the few common computer applications which isn't just an up to date version of something which existed before the computer. Word processors replaced typewriters, publishing packages replaced hot metal, and databases replaced card indexes but the spreadsheet was a totally new concept. Certainly we could say that it has elements in common with a manual ledger but to say it's just a ledger brought up to date would be significantly under-selling the spreadsheet – it's far more than that. A spreadsheet is a document which is divided into a large number of cells, each of which may contain text, a number or a mathematical formula. Cells are referred to by an address which is made up of the column identification (vertical) followed by the row identification (horizontal). In Excel, columns are referred to by letters or letter pairs (i.e. A, B, C....X, Y, Z, AA, AB, AC etc.) and rows are referred to by numbers. So, for example, the address of the top left hand cell is A1. With that small amount of introduction, let's jump straight in and see how a spreadsheet can be built up. If you have Excel, you might like to fire it up on your PC and try this example out, after all, many people find that doing is the best way of learning. I won't tell you about every mouse click and every press of the Enter key – I'll assume that if you're reasonably au fait with PC software you'll be able to figure out how to type something into a cell or delete it. Instead, I'll give high level instructions such as what to type into a cell. Of course, if you do have problems, you can refer to the on-line help. Our example is of a typical, albeit trivially simple, financial application. Specifically, we're going to generate a set of accounts for the fictitious company Acme Software Services which includes turnover, business expenses, gross margin, tax payable, and net margin. I make no apology for using a financial example to teach you the basics, after all, this is what most people use a spreadsheet for. Probably at the end of this tutorial your view of a spreadsheet will be similar to that of most spreadsheet users. Only then, once we have covered the basics, will we move on to look at how the spreadsheet can be used for more interesting applications.

1. Type **`Acme Software Services`** into cell A1 and `Accounts` **`FY97/98`** into A2. In the main, text is used for headings, annotations, labels and so forth and doesn't really affect things too much. As in programming, however, it's wise to include lots of explanatory text otherwise people won't be able to make sense of the spreadsheet later. If you want, you can select these cells and increase the font size or put the text in bold as is fitting for a main heading.
2. Now you need to enter the column headings. Specifically, type **`Q1, Q2, Q3, Q4`** and **`Year`** into cells B4, C4, D4, E4 and F4 respectively.
3. Similarly, enter the row headings **`Turnover, Expenses, Gross Margin, Tax`** and **`Net Margin`** into cells A5, A6, A7, A8 and A9 respectively.


Microsoft Excel - Acme
File Edit View Insert Format Tools Data Window Help
Arial
10
G18
=

	A	B	C	D	E	F
1	Acme Software Services					
2	Accounts FY97/98					
3						
4		Q1	Q2	Q3	Q4	Year
5	Turnover	200	220	250	230	
6	Expenses	51	54	58	57	
7	Gross Margin					
8	Tax					
9	Net Margin					
10						

Screenshot 1.

Microsoft Excel - Acme
File Edit View Insert Format Tools Data Window Help
Arial
10
F9
=

=SUM(B9:E9)

	A	B	C	D	E	F
1	Acme Software Services					
2	Accounts FY97/98					
3						
4		Q1	Q2	Q3	Q4	Year
5	Turnover	200	220	250	230	900
6	Expenses	51	54	58	57	220
7	Gross Margin	149	166	192	173	680
8	Tax	46.19	51.46	59.52	53.63	210.8
9	Net Margin	102.81	114.54	132.48	119.37	469.2

Screenshot 2.

You'll probably find that some of these headings have encroached into column B. None of the text is actually in column B, but it will, nevertheless, get obscured when you type something into column B. To remedy this, you'll have to adjust the width of column A.

4. Now, enter the turnover and expenses figures into the appropriate cells. Turnovers for the four quarters were 200, 220, 250 and 230 (in thousands of pounds) and expenses were 51, 54, 58 and 57. The spreadsheet should now look like Screen Shot 1.
5. It's now time to get Excel to do some calculations. Specifically, you need to evaluate the gross margin for each of the quarters. To do this for the first quarter, type **`=B5-B6`** into cell B7. As soon as you enter the formula, the result, namely 149, will appear in the cell. Note, however, that the formula still appears in the formula bar at the top of the page and can be edited here. Note also that all formulae start with an equals sign.
6. You could type similar formulae into cells C7, D7 and E7, but there's an easier way. Select cell B7 and while the mouse button is still held down, drag to the right to also select cells C7, D7 and E7 and then release. Now from the *Edit Menu,* select *Fill > Right.* The correct values will immediately appear in the appropriate cells. At first sight this might seem somewhat odd. Since you've copied the contents of a cell containing **`=B5-B6`** to the other cells, you might reasonably expect cells C7, D7 and E7 also to contain **`=B5-B6`** and hence show the value 149. If you look in cell C7, however, you'll notice that it contains **`=C5-C6`**. The reason for this is that, unless you specify to the contrary, spreadsheet references are relative rather than absolute and, in most cases, this gives you the desired result.
7. Now do the same with the tax and net margin rows. Assume that corporation tax is 31% so enter **`=0.31*B7`** into B8 and

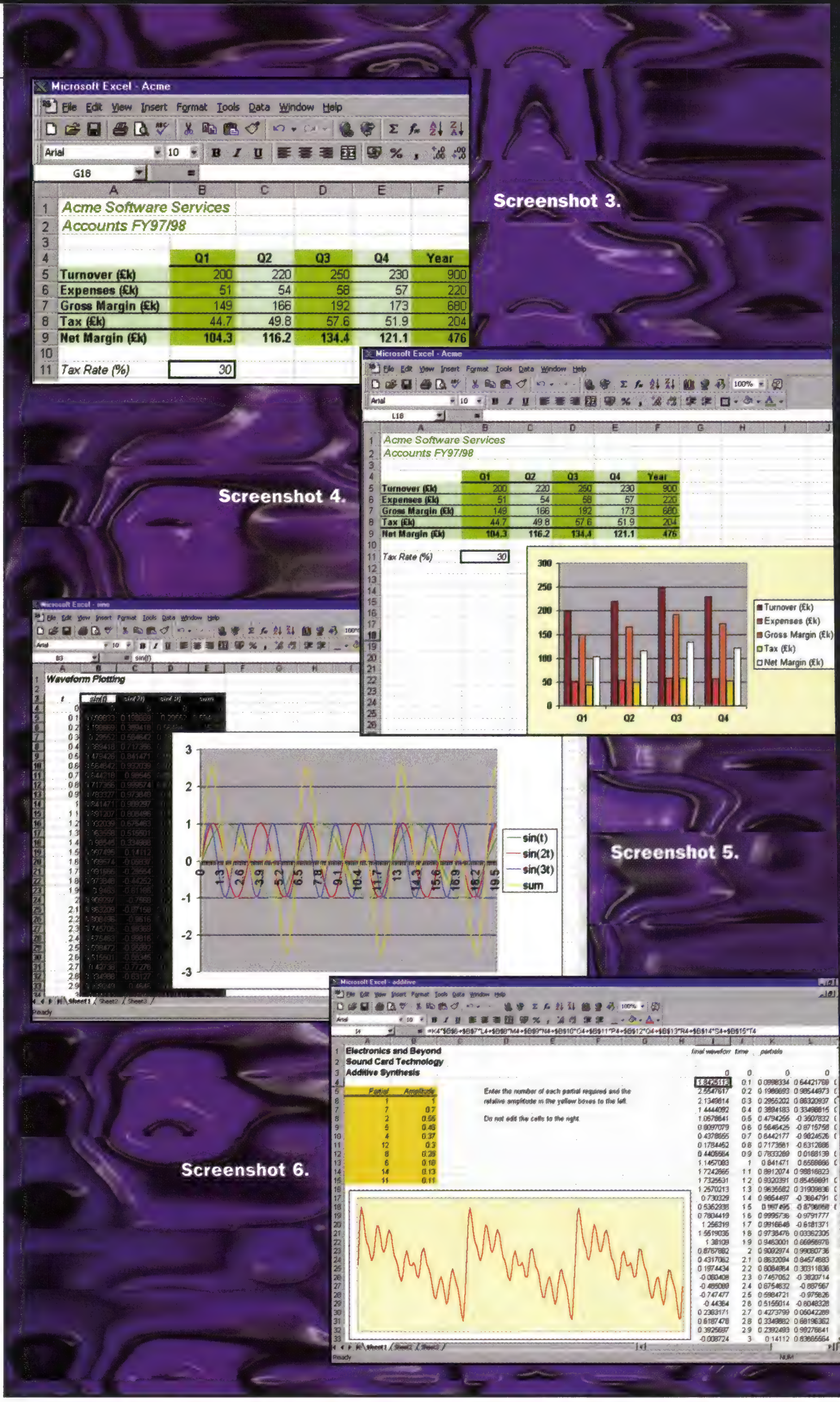
=B7-B8 into B9 and copy these formulae into columns C, D and E.

8. To complete the accounts, you need some totals for the year as a whole. You could enter **=B5+C5+D5+E5** into cell F5, but instead, use the SUM function by entering **=SUM(B5..E5)**. When you've entered this, copy it down to cells F6, F7, F8 and F9 and the spreadsheet is finished. You should have ended up with something similar to that in Screen Shot 2. Note that, for clarity, all the cells whose values are calculated automatically have been coloured red manually.
9. So far you have accounts which work with a fixed rate of corporation tax, namely 31%. Now you're going to modify the spreadsheet to work with any tax rate. First of all, type **Tax Rate (%)** into cell A11, followed by **31** into cell B11. Now you need to change the contents of cell B8 to access the value in B11 rather than relying on a hard-coded tax rate. To do this, replace the contents of B8 with **=B11/100*B7**. You'll notice that the value calculated remains the same, just as we'd expect.
10. To make the same changes to cells C8, D8 and E8 you might expect to fill right to these cells from B8. Try it out to see what happens. Unfortunately, you'll find that once you've made this change, cells C8, D8 and E8 contain the value zero – clearly something is wrong. To find out why, select C8 and take a look at the contents of the formula bar. Instead of **=B11/100*C7**, it contains **=C11/100*C7**. But, of course, it would – Excel references are normally relative. Whereas this is what you wanted before, you don't want an absolute reference in this case. To correct it, go back to cell B8 and type **=$B$11/100*B7**. This uses $B$11 which is the absolute form of an Excel reference. Now copy this to cells C8, D8 and E8 and you'll find that all is well. To prove that our spreadsheet now works with any tax rate, replace the contents of cell B11 with **30** and see all the tax and net margin figures change. Your spreadsheet should now look something like Screen Shot 3. You'll notice, however, that I've done some tidying up and I've coloured the table.
11. Now let's try something a bit different. Select the whole of the group of cells bounded by A4 at the top left and E9 at the bottom right. Now press the *Chart Wizard* button (the bar graph icon) on the tool bar, choose Column Charts in step 1, select *Series in Rows* in step 2, and accept the defaults in all the other steps. With a bit of luck, you should end up with a column chart of the data in the table like the one in Screen Shot 4.

Scientific Functions

What you've seen so far is a small fraction of the features available in Excel, but it's enough to perform many of the simple accountancy type tasks for which spreadsheets are often used. Indeed, many people don't progress much beyond this stage – as with most packages, 95% of people use no more than 5% of the features. So what else is there in Excel's repertoire which may be of interest to the mathematician or the scientist?

Our Excel tutorial included only very simple calculations. Specifically, you used the four standard mathematical operators, +, -, * and / plus the SUM function. But in common with most other common spreadsheets, Excel has a vast library of functions going far beyond the functionality required in most financial applications. First of all, it has all the mathematical functions you'd expect to find in a high level language, plus some you wouldn't find in the likes of Basic. So there's all the trigonometric, inverse trigonometric, hyperbolic, logarithmic and exponential functions. There's even factorial, double factorial and power series functions. Turning to the realm of engineering, we find about 40 functions including Bessel functions, base conversions, complex number functions and error functions, plus if you're into statistics, your needs here are also catered for in the function library.



Screenshot 3:

	A	B	C	D	E	F
1	*Acme Software Services*					
2	*Accounts FY97/98*					
3						
4		Q1	Q2	Q3	Q4	Year
5	Turnover (£k)	200	220	250	230	900
6	Expenses (£k)	51	54	58	57	220
7	Gross Margin (£k)	149	166	192	173	680
8	Tax (£k)	44.7	49.8	57.6	51.9	204
9	Net Margin (£k)	104.3	116.2	134.4	121.1	476
10						
11	*Tax Rate (%)*	30				

Screenshot 4:

	A	B	C	D	E	F
1	*Acme Software Services*					
2	*Accounts FY97/98*					
3						
4		Q1	Q2	Q3	Q4	Year
5	Turnover (£k)	200	220	250	230	900
6	Expenses (£k)	51	54	58	57	220
7	Gross Margin (£k)	149	166	192	173	680
8	Tax (£k)	44.7	49.8	57.6	51.9	204
9	Net Margin (£k)	104.3	116.2	134.4	121.1	476
10						
11	*Tax Rate (%)*	30				

Screenshot 6:

```
=K4*$B$6+$B$7*L4+$B$8*M4+$B$9*N4+$B$10*O4+$B$11*P4+$B$12*Q4+$B$13*R4+$B$14*S4+$B$15*T4
```

Electronics and Beyond
Sound Card Technology
Additive Synthesis

Partial	Amplitude
1	1
7	0.7
2	0.56
5	0.49
4	0.37
12	0.3
8	0.28
6	0.18
14	0.13
11	0.11

Enter the number of each partial required and the relative amplitude in the yellow boxes to the left.

Do not edit the cells to the right.

The second major areas of interest to the technically minded user is the graph plotting facilities. The facilities provided go beyond the simple column chart you used in the earlier example plus the bar, line and pie charts which are commonly used in business applications. For a start, there are multiple options for each of the major categories of graph and secondly, there's a wide range of chart types including scatter plots, polar graphs and surface plots.

This article is primarily a hands-on feature illustrated with plenty of examples of how the spreadsheet can be used for technical purposes. You'll notice that all the examples produce some sort of graphical output. Of course, this needn't be so, indeed many technical applications will produce nothing more visually exciting than tables of figures. Nevertheless, the aim of this article is to challenge a stereotypical view of the spreadsheet and to do this, I need to present some visually attractive results. So with that bit of introduction, it's time to launch into the first technical example which demonstrates how I produced some of the graphs in my recent article about synthesis techniques in PC sound cards. As an introduction to FM synthesis, I showed how the waveform of an

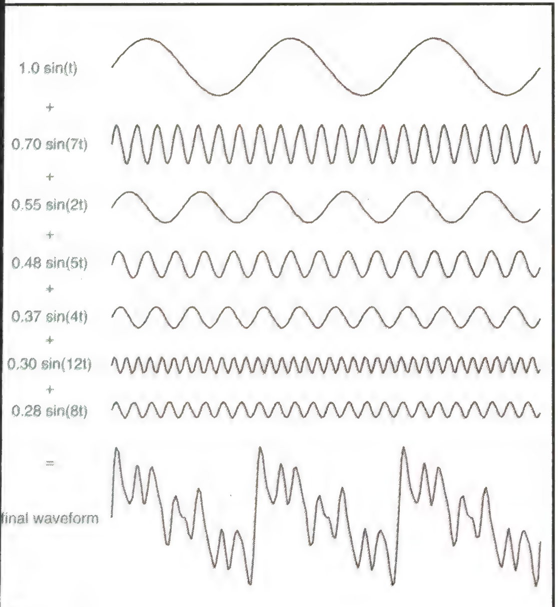


Figure 1.

nstrument can be built up by adding together ne waves of differing frequencies and mplitudes. This, of course, is the principle mbodied in the Fourier theorem. So let's art off by creating a graph of some variables lotted against an independent variable.

. Start with a new workbook and put a suitable title into cell A1. Now, put the column headings **`t, sin(t), sin(2t), sin(3t)`** and **`sum`** in cells A3, B3, C3, D3 and E3 respectively.

. Enter **`0`** into cell A4. This is the initial value of the independent variable *t*. Enter **`=A4+0.1`** into cell A5. 0.1 is the amount by which the independent variable will be incremented in each row.

. Enter **`=sin(A4)`**, **`=sin(2*A4)`**, **`=sin(3*A4)`** and **`=B4+C4+D4`** into cells, B4, C4, D4 and E4. Select cells B4, C4, D4 and E4 and fill down into row 5.

. Now select all the occupied cells in row 5 and fill down to rows 6 to 200.

. All you need to do now is plot the values in the table you've just created. So, select the block of cells bounded by B3 in the top left hand corner and E200 in the bottom right. Click on the *Chart Wizard,* in step 1 select line graph, and in the *'series' tab* of step 2, enter **`=Sheet1!$A$4:$A$200`** for Category *(X) axis labels.* Use the defaults in the remaining steps. You should end up with a result similar to the one shown in Screen Shot 5. So you've plotted sin(*t*), sin(2*t*), sin(3*t*) and sin(*t*)+sin(2*t*) +sin(3*t*) against *t*, but this really isn't a particularly sophisticated spreadsheet. If you were to experiment with adding together various combinations of sine waves, each with different amplitudes and frequencies, you'd have to make significant changes to the spreadsheet for each experiment. There has to be a better way, and there is, as Screen Shot 6 illustrates. This is the spreadsheet I used to generate some of the graphs in the sound card article in issues 126 and 127 of Electronics, and it uses a technique similar to that you used in the final version of the Acme Software Services spreadsheet to cope with a varying rate of corporation tax. The yellow box contains information on up to 10 harmonics (or partials) which contribute to the final waveform. For each harmonic, a frequency and amplitude are entered. Values for the appropriate sine waves are calculated in columns K to T (for example, cell K3 contains **`=SIN(J3*$A$6)`**) and these are scaled according to the amplitude and summed in column I. So, for example, the cell I3 contains **`=K3*$B$6+$B$7*L3+$B$8*M3+$B$9*N3+$B$10*O3+$B$11*P3+$B$12*Q3+$B$13*R3+$B$14*S3+$B$15*T3`**.

Before leaving the subject of plotting 2D functions, I'll say a few words about exporting graphs from Excel. This is a general point and doesn't really relate to the previous example but this is as good a time as any other to raise the topic. Having created a graph in Excel, a common requirement is to export it to another application, most typically, perhaps, a word processor or a graphics package. Of course, it's perfectly possible to cut and paste the graph but if you paste it into a graphics package in this way, you'll find that the graph cannot be edited using the graphics package. Since it will have been pasted into the graphics package as an Excel object, any attempt to edit the graph will simply launch you back into Excel. The answer is to use 'paste special' rather than paste, selecting 'picture' as the format in which the graph should be pasted. Now, the graphics package will see the graph in terms of familiar elements such as lines, text, curves and rectangles and can, therefore, by manipulated as normal. With some graphics packages, this option won't be available (for example, Corel Draw 5 doesn't give the 'picture' option under paste special) but this problem can usually be circumvented by using some intermediary package. For example, the solution I adopted was to paste special into Word and then cut and paste from Word into Corel Draw. Figure 1 shows an illustration I created in Corel draw from a number of graphs exported from the previous spreadsheet. It illustrates how the waveform of an instrument can be built-up by adding together sine waves.

Surface Plotting

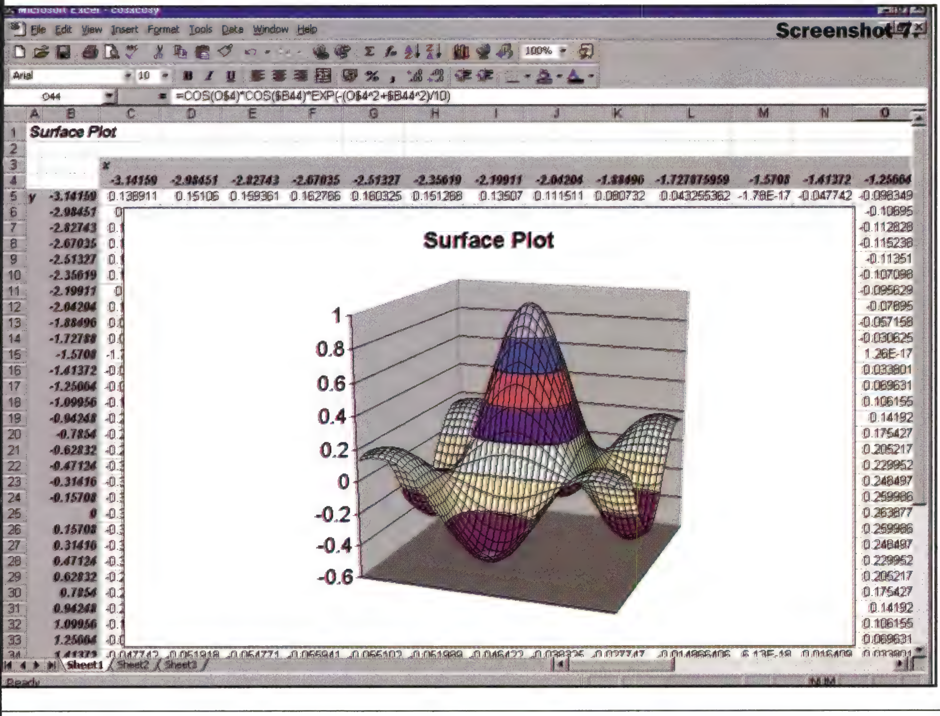
OK, let's now move away from two dimensional graphs and investigate the world of three dimensions. In mathematics and engineering, it's a common requirement to plot functions of two variables. Now, of course, rather than a line graph, a surface plot is needed in order to be able to visualise the function. To illustrate this, the following example is of a spreadsheet to generate a surface plot of the function

$$\cos(x)\ \cos(y)e^{-(x^2+y^2)/10}$$

for values of x and y between -π and +π.

1. Start with a new workbook and put the title **`Surface Plot`** in cell A1. Now put x in cell C3 and y in A5.
2. Now type **`=-PI()`** into cell C4 and **`=C4+PI()/20`** into cell D4. Fill right from D4 into cells E4 to AQ4. You'll find that cells C4 to AQ4 now contain values from -π (approximately -3.14159) to +π (approximately +3.14159) in steps of π/20.
3. Using a similar technique, put values of -π to +π in steps of π/20 into the column of cells from B5 to B45.
4. The next task is to populate the matrix of cells bounded in the top left hand corner by C5 and in the bottom right by AQ45 with the values of $\cos(x)\ \cos(y)e^{-(x^2+y^2)/10}$ corresponding to the x values in the column headings and the y values in the row headings. To do this, type **`=COS(C$4)*COS($B5)*EXP(-(C$4^2+$B5^2)/10)`** into cell C5 and fill both down and right to AQ45. You'll notice that this uses a form of the cell reference which you haven't used in the earlier example. C$4 has a relative column and an absolute row reference whereas $B5 has an absolute column and a relative row reference.
5. To draw the surface plot, select the block B4:AQ45, click on the *Chart Wizard,* select surface plot in step 1 and accept the default values in the other steps. You should get results like those in Screen Shot 7. Note that, as alternatives, you could have selected a wire-frame version of the surface plot or a contour plot.

Next month we will take a look at simulation and other possibilities including *Julia* and *Mandelbrot Sets.*



Screenshot 7.

```
=COS(O$4)*COS($B44)*EXP(-(O$4^2+$B44^2)/10)
```

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Surface Plot														
2															
3			x												
4			-3.14159	-2.98451	-2.82743	-2.67035	-2.51327	-2.35619	-2.19911	-2.04204	-1.88496	-1.727875959	-1.5708	-1.41372	-1.25664
5	y	-3.14159	0.138911	0.15106	0.159361	0.162786	0.160325	0.151268	0.13507	0.111511	0.080732	0.043255362	-1.78E-17	-0.047742	-0.098349
6		-2.98451													-0.10695
7		-2.82743													-0.112828
8		-2.67035													-0.115238
9		-2.51327													-0.11351
10		-2.35619													-0.107098
11		-2.19911													-0.095629
12		-2.04204													-0.07895
13		-1.88496													-0.057158
14		-1.72788													-0.030625
15		-1.5708													1.26E-17
16		-1.41372													0.033801
17		-1.25664													0.069631
18		-1.09956													0.106155
19		-0.94248													0.14192
20		-0.7854													0.175427
21		-0.62832													0.205217
22		-0.47124													0.229952
23		-0.31416													0.248497
24		-0.15708													0.259986
25		0													0.263877
26		0.15708													0.259986
27		0.31416													0.248497
28		0.47124													0.229952
29		0.62832													0.205217
30		0.7854													0.175427
31		0.94248													0.14192
32		1.09956													0.106155
33		1.25664													0.069631

IBUS APPLICATIONS

Neil Johnson, of Cambridge Consultants Ltd of looks at a number of applications for the IBUS modules, together with a set of guidelines, hints and tips for those interested in designing their own IBUS modules.

An overview of the IBUS PC expansion system is shown in Figure 1. The Parallel Port Adaptor (PPA) interfaces the PC's parallel printer port to the IBUS. The IBUS, in turn, connects to a number of Expansion Modules (EM) which provide some interfacing function to the Real World, be it a sensor, a motor or something completely different.

The list of IBUS modules, and the issues of Electronics and Beyond in which they appear includes:

Parallel Port Adaptor (issue 119)
Digital Input/Output module (issue 122)
Opto-isolated Input module (issue 123)
Relay Output module (issue 124)
Analogue Input module (issue 125)
Analogue Output module (issue 126)

If you missed any of these projects, back issues or reprints are available from the editorial office.

Examples and Ideas

To help get your creative juices flowing here are five example applications for the IBUS modules. Note that not all of the modules are used in any one example, but rather a combination of two or more expansion modules are sufficient to build a versatile and capable system. For reasons of clarity the controlling PC and the PPA are omitted from the illustrations.

1) Model Train Set

For model railway enthusiasts the IBUS offers a convenient way to modernise your layout. The three basic elements are shown in Figure 2.

A relay output module (RO) is ideal for implementing a track isolation system. The specified relays should be adequate for switching the relatively low voltages used to operate model trains – even when pulling the 17:10 12-car evening commuter service!

On the signalling side, the digital I/O module (DIO) offers a range of inputs suitable for connecting to a number of reed-switch train position detectors. Once your computer knows where a train is it can use this information to operate a track status panel display on the computer monitor. This information can also feed into the signalling system The outputs of the DIO are capable of operating small LEDs, ideal for making modern multi-aspect colour-light signals. Sneaky tip: place a train detector next to a stop signal, then if an errant driver passes a signal at danger, your computer can set off an alarm!

2) Audio/Visual Presentation

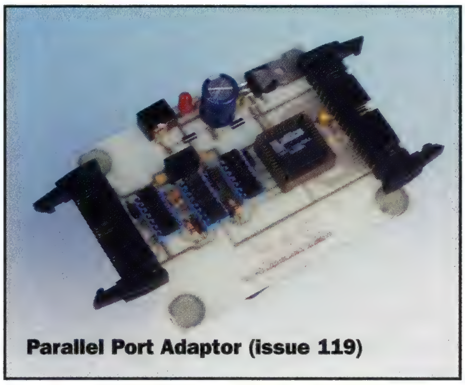
For those of you keen on organising your own slide shows, the IBUS system can ad a touch of professionalism. For this application the RO module comes into its own, as shown i Figure 3.

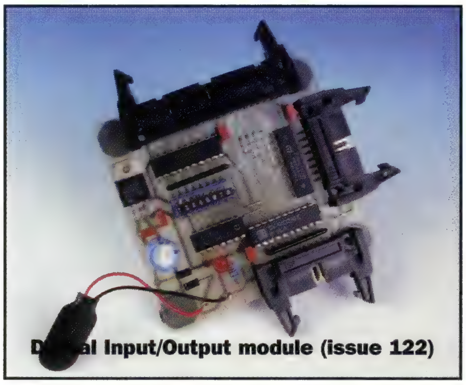
The set of eight relay switche are able to control a range of useful devices. In the example shown, a tape player can be started and stopped using its REMOTE socket. A set of low voltage spotlights, as favoured in trendy clothes shops and cafes, can be turned on and off during the presentation, or even during a refreshment break. More importantly, one o more slide projectors can be operated in sequence with the rest of the system.

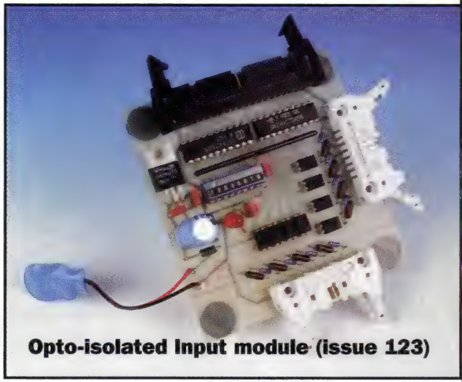
To provide some means of remote control for the presenter a remote handset can be connected to the IBUS system with a DIO module. As well as the essential start and stop functions, the remote control could include a pause button and some extra controls for operating the slide projectors.

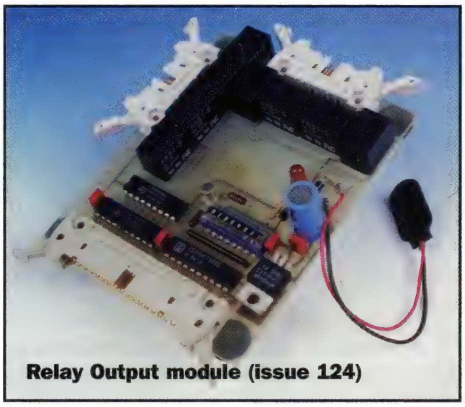
3) Automatic Greenhouse Manager

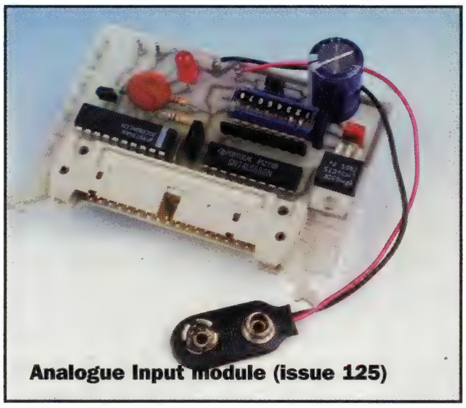
As any gardener knows, a greenhouse needs constant attention – water, ventilation, light, and so on, all need

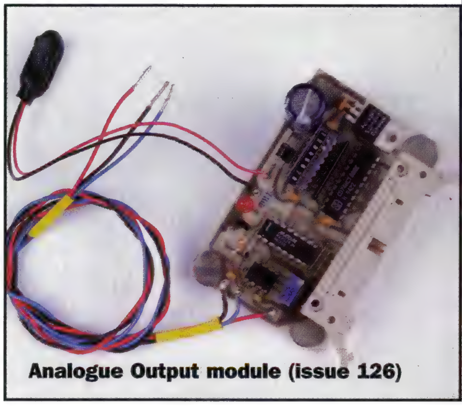

Parallel Port Adaptor (issue 119)


Digital Input/Output module (issue 122)


Opto-isolated Input module (issue 123)


Relay Output module (issue 124)


Analogue Input module (issue 125)


Analogue Output module (issue 126)

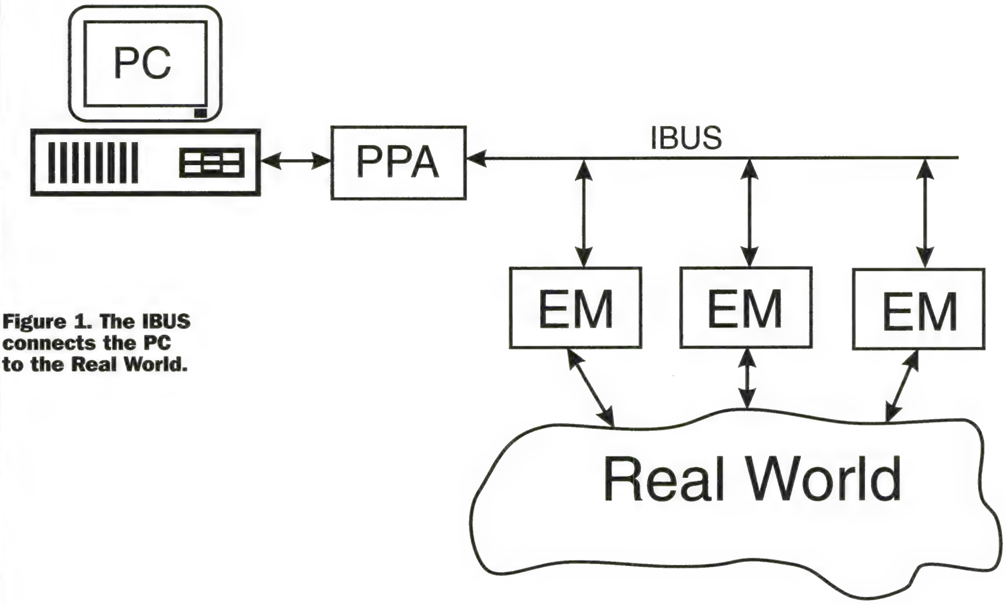


Figure 1. The IBUS connects the PC to the Real World.

onitoring and controlling. ow, with the aid of your PC, he IBUS system and some rafty DIY, you can place your reenhouse under computer ontrol, see Figure 4.

The analogue input module AI) can be used to monitor a ange of environmental factors, or example ambient heat and ght levels, and soil moisture. his information can then be sed to operate a water prinkling system using the RO odule and an electrically- perated water valve. For the ore adventurous, you could otorise your greenhouse indows and have them open nd close throughout the day.

4) Automatic Power Supply

ack in the lab, a computer- ontrolled power supply has a umber of uses – circuit testing, attery charging, experiments, nd so on. Figure 5 outlines a asic IBUS-controlled bench ower supply.

The output voltage is egulated by the Voltage egulator, whose reference nput is provided by an AO odule. The output voltage can hen be set to one of 256 steps. For example, if the gain of the egulator was set to 10, the utput range would be 0V to 24.9V, in steps of 9.77mV.

The current sensing circuitry ould be based on a sense- esistor and differential mplifier, whose output voltage ould be proportional to the urrent flow. An AI module ould then sample this signal to monitor the current being taken by the load.

Finally, an RO module could provide output switching, either to a single set of terminals, or as part of a multi-output power management system.

5) Radio Shack Control System

The modern radio shack is full of computers – from PCs to log calls and operate packet systems, to embedded computers in today's multi-functional DSP-enhanced turbo-charged radio gear. Equip your PC with the IBUS and put your shack under complete control (Figure 6).

The two analogue interfacing modules – AI and AO – would be suitable for operating an antenna rotator. The AO module would set a voltage to drive the servo motor, while the

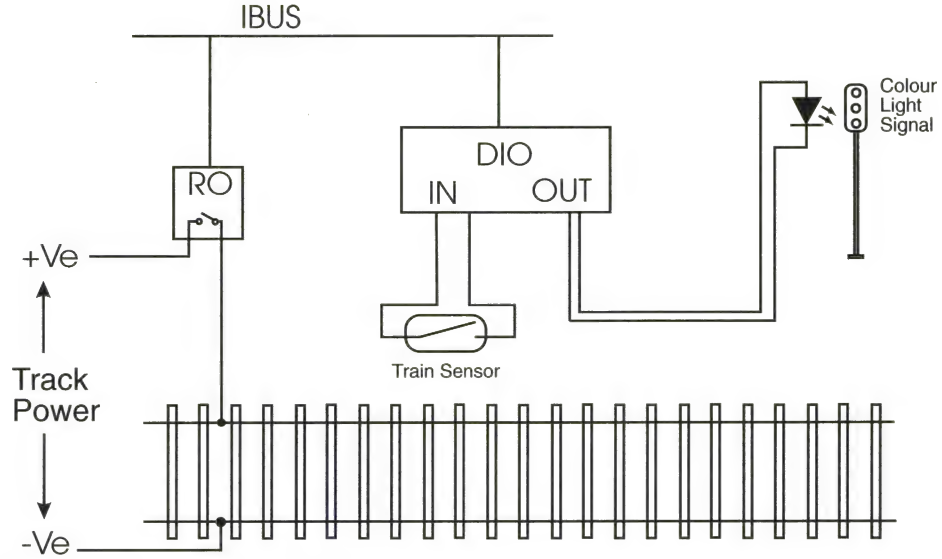
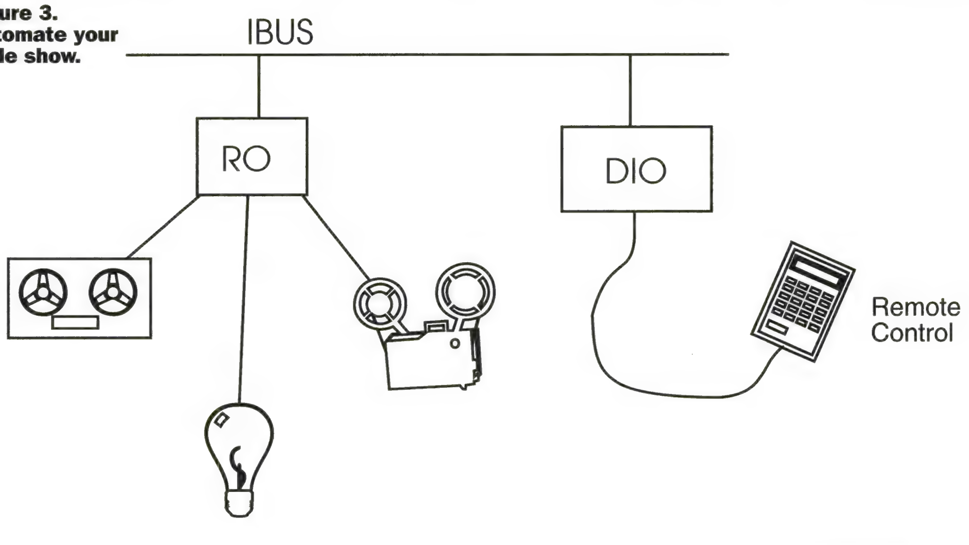


Figure 2. Modernise your model railway layout.

Figure 3. Automate your slide show.



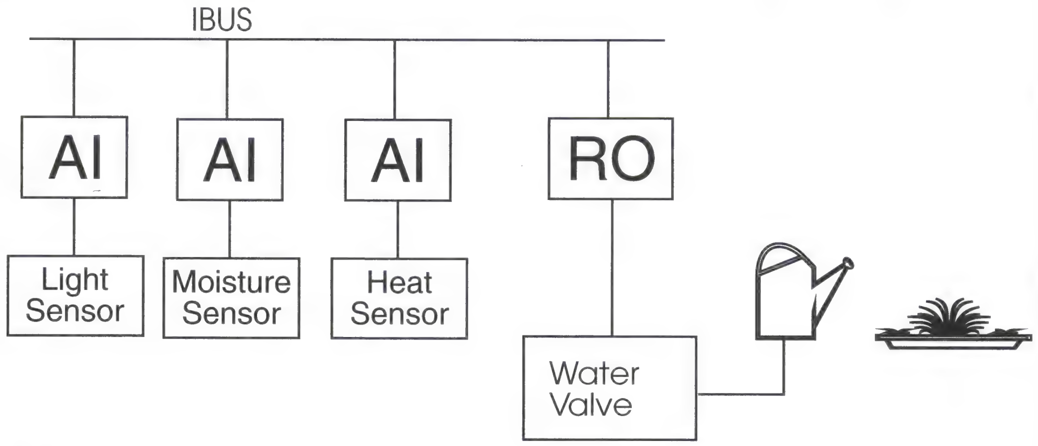


Figure 4. The computerised greenhouse.

AI module would monitor the actual progress of the antenna via a rotary position sensor.

With two or more antennas, or transmitters, some sort of RF switching system will be needed. For automatic control a number of RF relays, specially constructed to handle the high frequency signals, can be operated by an RO module. In the example shown, two transmitters and two antennas can be connected via three RF relays in various configurations.

Another key use of the IBUS system is to monitor the status of your equipment. The inputs of the DIO and the OI modules should be suitable for monitoring the status of a number of devices, including power supplies, power amplifier fault status outputs, transmitters, and so on.

These are just some of the many possible applications of the IBUS modules. These modules can be likened to children's building bricks – use them together to build complete systems of monitoring and control.

For those not content to use the basic set of IBUS modules, but would rather design their own custom modules, the rest of this article will discuss some guidelines for creating your own, together with some hints and tips fresh from the author's pen.

Design Guidelines

The first, and maybe golden, rule of the IBUS system is to connect only one pin to each IBUS line. For the address bus this means only one logic input per address line, while for the data bus this expands to a single input, a single tri-state output, or a combination of the two, as used in the DIO module. This limits the loading placed on each IBUS line, especially important if there is a long run of cable between the PPA module and the expansion module(s).

The bus cycle time of the IBUS system is quite slow, especially when compared to the break-neck bus speeds found inside a powerful PC, running in excess of 33MHz. This means the timing constrain for bus interfacing logic are relaxed, allowing simpler and cheaper circuits to be built.

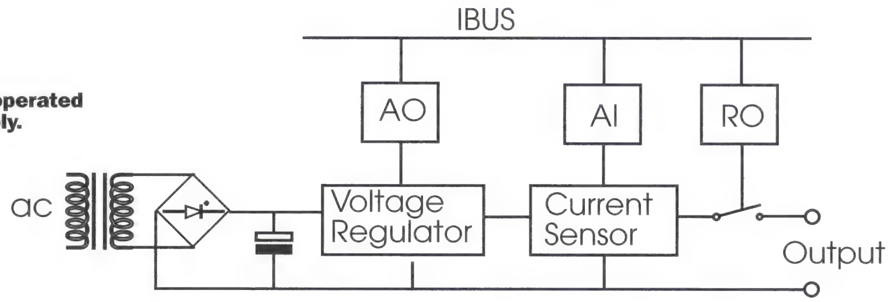
To help ensure compatibility between IBUS modules and to maximise the use of the 256 available addresses, it is suggested (although not absolutely essential) that all modules occupy at most two consecutive address locations, and are evenly aligned (i.e. starting addresses of 00, 02, 04 etc)

For modules that require more than two addresses a dua register scheme is suggested, and is already used by some PC graphics cards. This uses a combination of a write-only address register and a read/writ data register to access the full set of internal registers in the module. The address register specifies which internal register can be viewed through the data register. Figure 7 shows how this scheme might be implemented (this is not a complete schematic – some extra logic may be required for line buffering and to control the direction of the data register).

The bottom address bit, A0, selects either the data register (bus transceiver) or the address register (a latch). The remaining seven address bits are matched against the module address, set by the DIP switch. The other logic gates operate the various registers and ensure control signals only reach the internal logic when required.

Although a regulated +5V is available from the IBUS itself, it should not be used to provide more than a few milliamps. For very long lengths of cable the impedance of the supply lines

Figure 5. Computer-operated power supply.



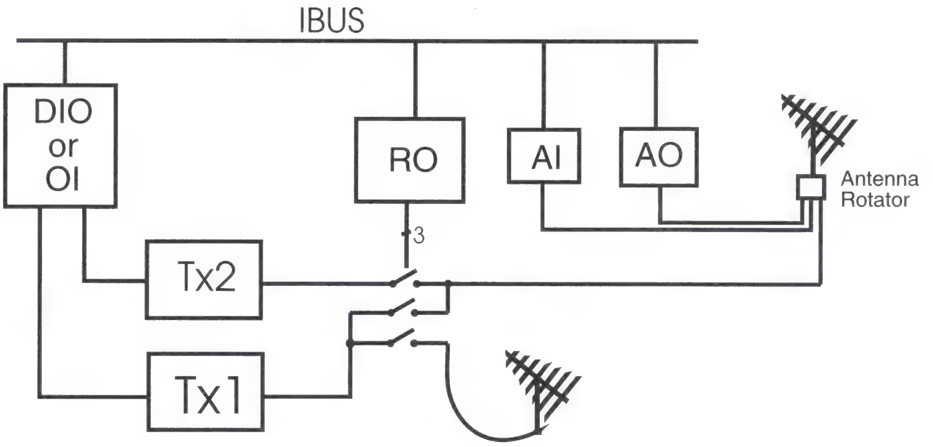


Figure 6. Automate your radio station.

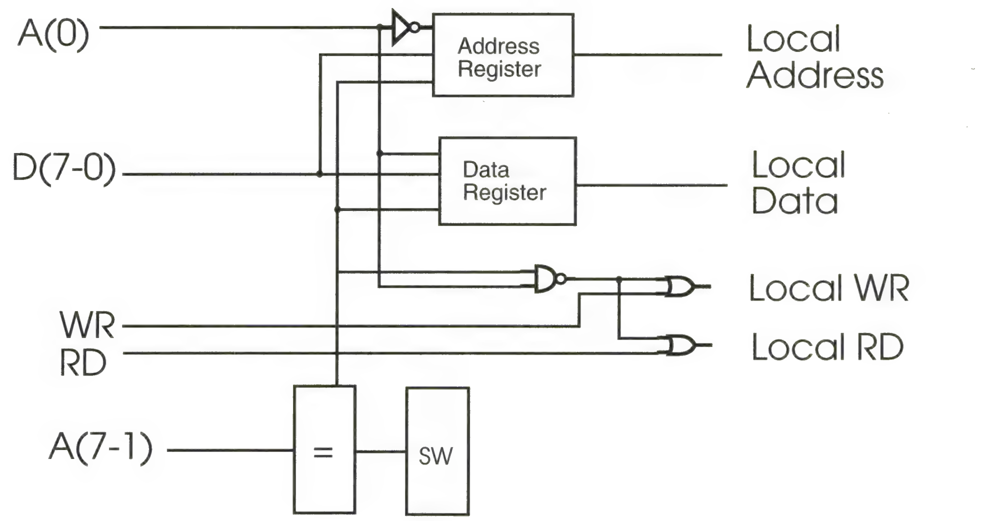


Figure 7. Address and data register circuit.

the high frequency switching oise of the logic circuits could use glitches on the supply ils, which in turn could cause roblems for latches, registers, ounters etc.

In the true spirit of the IBUS stem, try to move as much omplexity of the design over the software part of the stem, making the hardware as mple, low cost and reliable as ossible. It is also much easier modify your program to do omething else, or add some ew feature, than it is to modify rebuild the hardware.

If a control register needs ore than 8-bits of resolution, r example to control the equency of a signal generator, onnect multiple data registers parallel. Figure 8 shows how get 16-bits of data. Adding ore registers in parallel will crease this to any desired nge. It is suggested, although ot required, that the lowest yte is at the lowest address, nd the highest byte at the ighest address.

Finally, a general tip for all esigners of logic circuits. For esigns where the logic omplexity is going to exceed ore than a few chips consider sing a complex PLD. In articular, the one used for the BUS PPA, from the Lattice emiconductor In-System rogrammable range, provides omewhere in the region of 000 logic gates, including 32 /O pins and 96 registers. ecause they can be rogrammed in-circuit, no pecial logic programmer is eeded to program them – just spare printer port and a copy f the download software. A full uite of design software, ncluding schematic and HDL ntry, functional simulation, esign management, and a full-eatured logic compiler, is included for free on the data CD, available from Maplin (order code VR37S).

Closedown

We have now reach the end of this series of projects that make up the IBUS PC Expansion System. Over the past nine months (the original IBUS PPA appeared in issue 119 of the magazine) we have seen the designs for a complete set of modules sufficient to cater for most simple, and some not-so-simple, PC interfacing projects.

To the electronics hobbyist of old who spent their evenings plugging home-brew boards into their ZX81, VIC-20, BBC computer, or whatever, and who were horrified by the overwhelming complexity of the PC, I dedicate this series. Go forth and automate!

Acknowledgements

The author would like to express his thanks to Cambridge Consultants Ltd, Cambridge, for their help throughout this series of projects. In particular, Steve Barlow for his timely words of advice, and Colin Attenborough for his epigrammatic observations on the mystical workings of the PC. And big hugs to Helen.

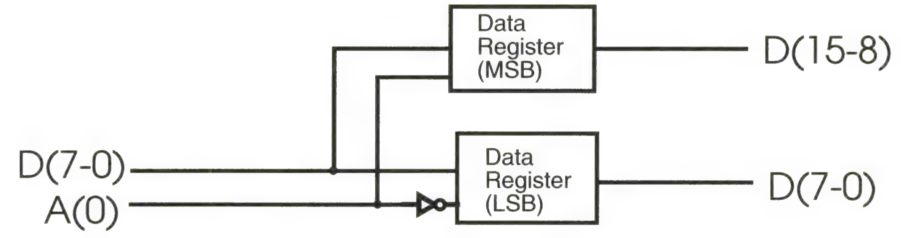


Figure 8. Expanding the data bus.

MAPLIN
Gift Token
MAPLIN GIFT TOKENS MAKE THE PERFECT GIFT!
Tokens are available from all Maplin Stores in denominations of £5.

Gift Token
£5
SPECIMEN
This Gift Token may be used in any Maplin Store or by Mail Order.
SIGNATURE

Security
ELECTRONIC SYSTEMS & CIRCUITS
PART 10

Ray Marston describes a variety of add-on automobile security circuits in this final episode of the series.

Introduction

All previous episodes of this series have dealt with security circuits that are designed for use in domestic, commercial or industrial applications. By contrast, this concluding episode deals exclusively with fairly simple 'add-on' security circuits designed for use in automobiles fitted with normal 12V negative-ground electrical systems.

Modern automobiles virtually bristle with various 'security' devices and gadgets that are designed to enhance the vehicle's safety, reliability, mechanical efficiency, and immunity to theft. If you own a reasonably modern (post 1994) automobile, it is probably already so well equipped with good security devices that you will not need to add any more. If, on the other hand, your vehicle dates back beyond 1989, you may be able to gain by fitting one or more of the simple circuits that are described in this article, or by using one or more of the various commercial 'add-on' vehicle security units that are widely available.

The circuits described here include simple engine immobilizers and anti-theft alarms, 'lights-are-on' alarms, a headlight time-delay switch, and a timed auto-turn-off rear-screen heater controller.

Vehicle Immobiliser Circuits

Most immobilisers work by disabling the vehicle's engine, thus minimising a thief's chances of starting or driving the automobile. The simplest and most effective way to immobilise a vehicle fitted with a normal petrol engine is to physically remove its ignition system's rotor-arm. This task (which was compulsory in the UK during WW2) only takes half a minute to perform, and is recommended whenever a vehicles is left parked in a public area for more than a few days, but is too inconvenient a practice for every-day use. Instead, simple and convenient immobilisers can take the form of a secret switch (or remotely-controlled relay contacts) wired into some vital electrical part of the vehicle's engine; Figures 1 to 4 show some basic circuits of this type.

Figures 1 and 2 show how immobilisers can be wired into the engine's ignition system. In Figure 1(a), switch S1 is wired across the engine's contact-breaker (CB) points; when S1 is open the ignition operates normally, but when it is closed the CB points are shorted out and the engine is unable to operate. This simple circuit gives excellent protection, particularly if the wiring is carefully concealed at the CB end, but S1 must be able to handle the coil's high operating current when it is closed, and be able to withstand the CB point's typical 600V peak-to-peak 'ringing' voltages when the engine is operating normally.

The improved immobiliser circuit of Figure 1(b) does not suffer from the above snags. Here, an inexpensive and easily available 18V transient suppressor diode (D1) – which acts like a pair of back-to-back Zeners – is wired in series with S1. This device passes no current until its applied voltage exceeds 18V, and acts like a near-short to voltages greater than 18V. Thus, in this circuit, S1 passes zero dc current whe it is closed, but kills the ignitio systems vital 'ringing' voltages when an attempt is made to sta the engine. This circuit gives superb anti-theft protection.

In Figure 2 the immobiliser switch is wired in series with the vehicle's ignition switch, s that the engine operates only when the switch is closed. The protection offered by this widely-used type of circuit is not quite as good as that of Figure 1, since a moderately skilled thief can easily by-pass the immobiliser and ignition switches by simply hooking a wire from the battery to the S terminal of the ignition coil.

Figure 3 shows how a heavy-duty immobiliser switch can b wired into the vehicle's electri starter system, so that the starter only operates if this switch is closed. This system gives better protection than that of Figure 2, but is not as good as Figure 1 because the starter solenoid can be operated manually on many ol vehicles, and also because the starter and immobiliser switches can be by-passed by a single length of wire.

Finally, Figure 4 shows how an immobiliser switch can be wired in series with the electri fuel pump on suitable vehicles, so that the pump only operate when this switch is closed. Note that this system lets a thief start the engine and drive for a short distance on the carburettor's residual fuel, which is quickly used up.

A weakness of the Figure 1 t 4 circuits is that they must all b turned on and off manually, an thus only give protection if the owner remembers to turn the on. By contrast, Figure 5 shows an immobiliser that turns on automatically when an attempt is made to start the engine, but can be turned off by briefly

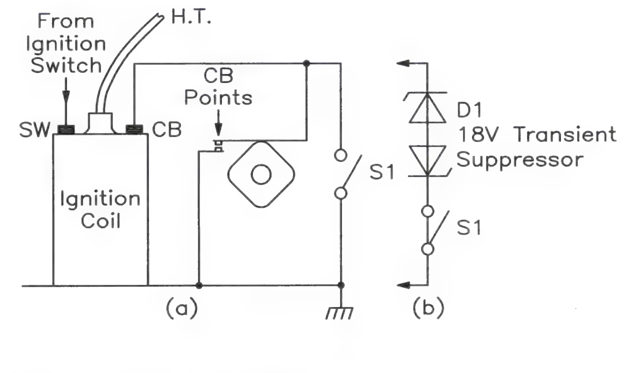


Figure 1. Contact-breaker immobiliser, operates when switch is closed.

Figure 2. Ignition immobiliser, operates when switch is open.

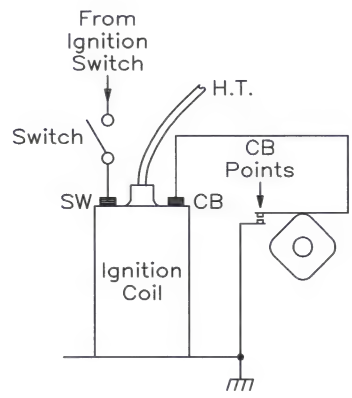
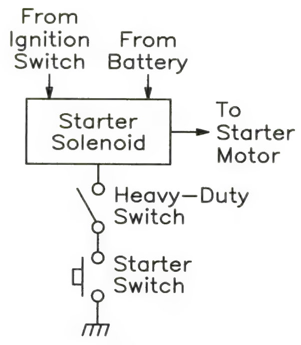


Figure 3. Starter-motor immobiliser, operates when switch is open.



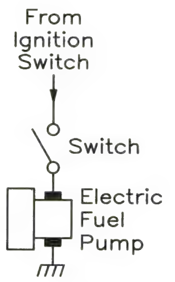


Figure 4. Fuel-pump immobiliser, operates when switch is open.

perating a hidden push-button witch. A small 'reminder' LED urns on when the engine is isabled by the immobiliser. his circuit thus gives a high level f protection, since it does not epend on the memory of its wner, and operates as follows.

The coil of 12V relay RLA is hunted by series-connected R1 nd a LED, which illuminates hen RLA is on, and this ombination is wired in series ith 1000μF capacitor C1, hich is shunted by series-onnected n.o. relay contacts LA/1 and n.c. push-button witch S1; this RLA-C1 ombination is wired between he ignition coils' SW terminal nd ground, and the relays' LA/2 n.o. contacts are wired cross the vehicle's CB points using a Figure 1b connection).

Normally, C1 is fully ischarged; consequently, when he ignition switch is first closed surge of current flows hrough RLA coil via C1, and he relay turns on and the LED lluminates. As the relay goes n, contacts RLA/1 close and ock the relay on via S1, and ontacts RLA/2 close and short ut the vehicle's CB points, thus mmobilising the engine. The elay stays on until S1 is briefly pened, at which point the elay unlatches and C1 charges p rapidly via the relay coil, and he relay and LED then turn off. s the relay turns off, it removes he short from the vehicles' CB oints, and the engine is able to perate in the normal way.

Anti-Theft Alarm Circuits

ehicle anti-theft alarms come n a variety of basic types, and he most reliable of these are he types that are switched n/off externally (rather than nternally) and are activated via simple door-controlled microswitches or via a battery-oltage sensing circuit. In modern vehicles, the external n/off control function is usually obtained via an IR remote-control system, but on older vehicles it can be obtained cheaply and simply via a prominent key-switch (or a concealed toggle switch) fitted to the outside of the vehicle. Figures 6 and 7 show practical alarm systems of these types that are designed for use in older vehicles; each of these circuits can also act as an immobiliser, and (if required) operates the vehicle's horn and lights and immobilises the engine under the 'alarm' condition.

In Figure 6 circuit, microswitches that are built into the vehicle are used (when the alarm system is enabled) to trip a pair of self-latching relays when any of the car doors, bonnet or boot/tailgate are opened; these relays immobilises the engine and operates the horn and headlights either directly or via additional timing circuitry. Two suitable front-door microswitches are built into most vehicles as standard fittings and are used to operate the courtesy or dome lights; additional dome-light-operating microswitches, which are readily available from specialist 'vehicle security' retailers, can easily be fitted to the rear doors. Similar microswitches can be used as 'auxiliary' switches to protect the bonnet and boot.

In Figure 7, RLA turns on and self-latches but as contacts RLA/1 close they connect the full battery voltage across the RLB-driving timer-gated asymmetrical pulse generator formed from a 4001B CMOS IC and Q1. This generator is activated for about four minutes, via R1-C1, whenever RLA is turned on by a 'break-in' detector, and repeatedly pulses RLB (and thus the vehicle's lights and horn) on and off, for unequal periods, for the duration of this 4-minute period. During this 'pulsing' period, the 'off' time of RLB is controlled by C2-D3-R3 and approximates 1.5secs, and the 'on' time is controlled by C2-D4-R4 and approximates 4secs, and the vehicle's horn thus generates a distinctive and

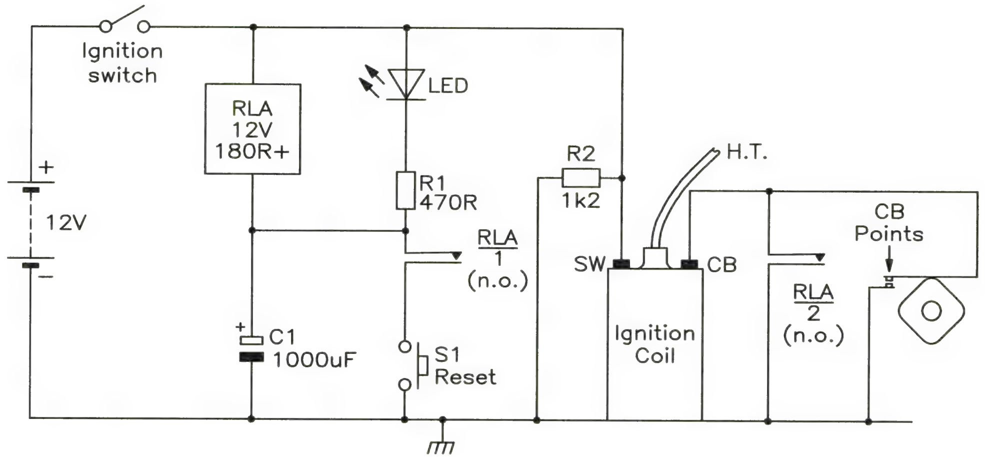


Figure 5. Self-activating immobiliser circuit.

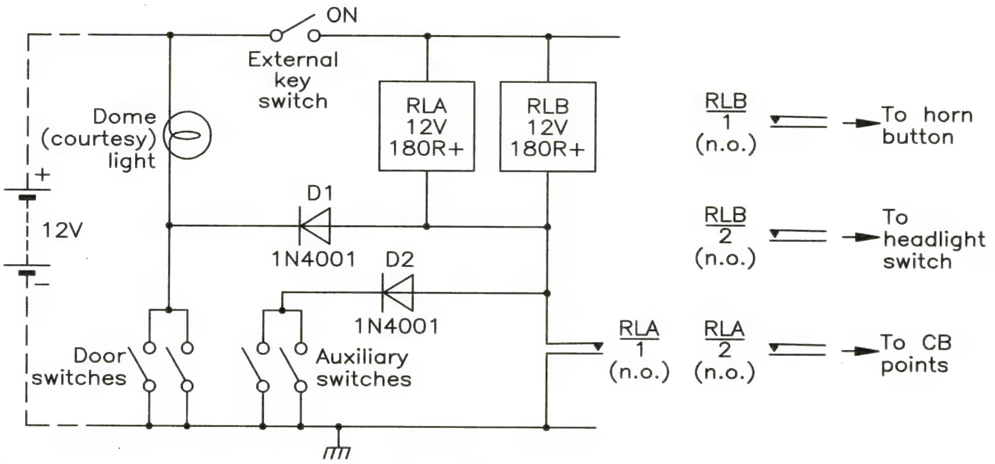


Figure 6. Basic microswitch-activated anti-theft alarm/immobiliser.

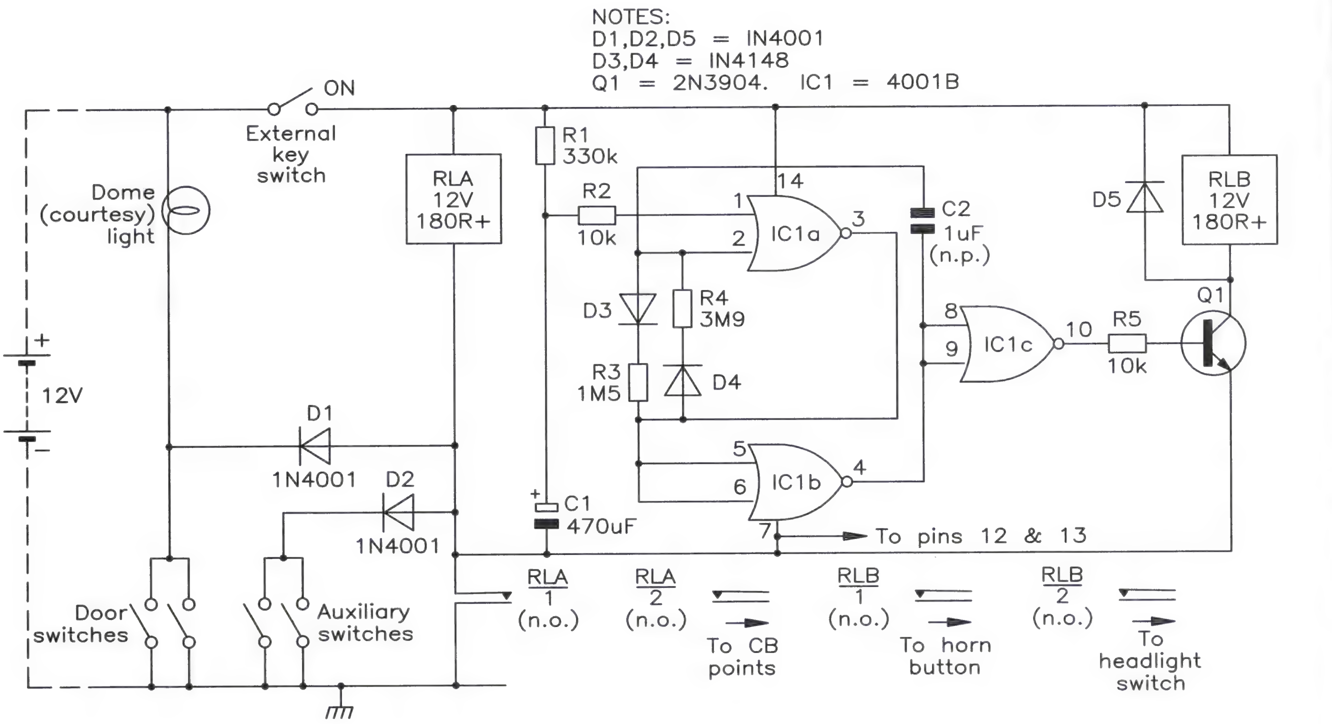


Figure 7. Improved anti-theft alarm/immobiliser has pulsed and time-controlled outputs.

easily recognised warning signal. Note that C2 is a non-polarised (n.p.) capacitor.

Finally, to complete this look at anti-theft alarm circuits, Figure 8 shows the practical circuit of a simple voltage-sensing type of alarm unit that can be used in place of the basic RLA-driving network used in the Figure 6 design. Circuit operation relies on the fact that (when the vehicle's engine is not operating) a small but sharp drop occurs in the vehicle's battery voltage whenever a courtesy light is automatically turned on by the opening of a front door, or when the ignition is switched on. This sudden drop in voltage is detected and made to operate RLA. The system has the advantage that its 'alarm' signals are derived directly from the vehicle's battery, rather than via various microswitches, but it is not quite as reliable as a conventional microswitch-activated alarm system.

The operation of the Figure 8 circuit – which is connected across the vehicle's battery via S1 – is fairly simple. Here, potential divider R1-R2-R3 is wired across the circuit's supply lines, and the output of this divider is fed, via RV1-R4, to the inverting (pin-2) input terminal of the 741 op-amp, which is wired in the open-loop mode, but is taken to the non-inverting (pin-3) input via a simple (R5-C1-R6) time-delay 'memory' network. A small offset voltage can be applied between the two input terminals via RV1. Note that this circuit responds only to sudden drops in voltage, and is not influenced by stable absolute values of battery voltage.

The Figure 8 circuit can be used directly in place of the RLA network in the Figure 6 circuit. When installing the circuit in a vehicle, RV1 must be carefully adjusted so that the alarm turns on reliably when the courtesy (dome) light goes on, without being excessively sensitive to the small shifts that occur in the battery voltage due to its chemical action. To find the correct setting of RV1, temporarily disable self-latching contacts RLA/1, and temporarily replace the courtesy lamp with one having roughly half its normal current rating. Now adjust RV1 just past the point where RLA fails to activate whe the lamp goes on, and then turn RV1 back a fraction, so tha RLA is just activated by the courtesy light. Now refit the original courtesy light, and recheck the action. If reliable action is obtained, re-enable the RLA/1 contacts.

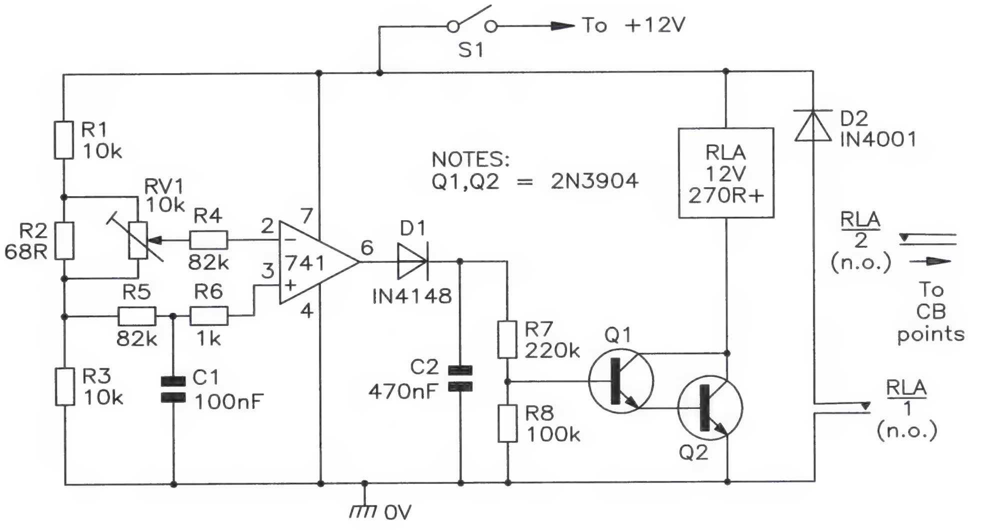


Figure 8. Basic voltage-sensing alarm circuit.

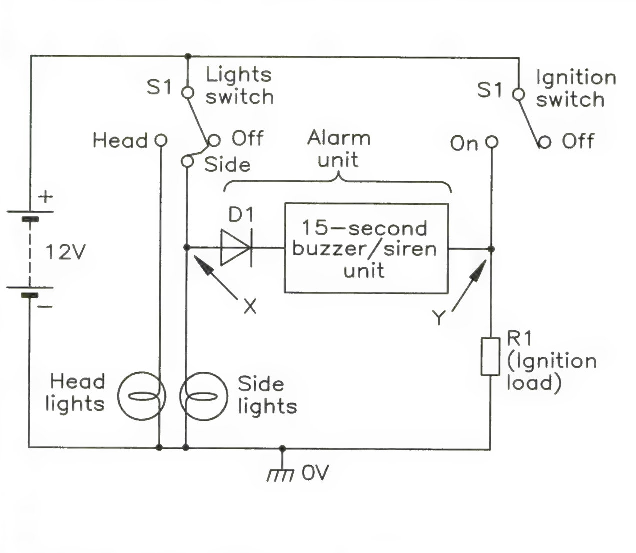


Figure 9. Basic Type-1 'lights-are-on' alarm circuit.

nstalling nti-Theft Alarms

he anti-theft alarms described the last section are all esigned to be turned on and ff via an externally mounted witch, which may take the orm of a carefully hidden toggle witch or a prominently ounted key-switch. In either ase, the switch must be mounted o that neither it or its wiring is ulnerable to damage by weather, irt or potential car thieves.

Once the alarm's external n/off switch has been fitted, he next installation job is to fit uitable microswitches to ctivate the system. Two uitable switches are already itted to most vehicles, and are sed to operate the dome or ourtesy light. Additional witches must be fitted to the ear doors, and must also be itted to the boot and bonnet if ull anti-theft protection is to be btained. Note that if your ehicle is fitted with a voltage-ensing type of alarm system, hese microswitches must be sed to switch a normal ilament lamp; the higher the oad current used, the more eliable will be the operation of he alarm circuit; the microswitches can all be wired n parallel and used to drive a ingle load. When installation is omplete, give your system a omplete functional check, aking care not to annoy your eighbours in the process.

Lights-Are-On Alarms

Most modern automobiles are itted – as standard equipment – with a lights-are-on reminder nit that emits a low-power udible alarm signal that warns the driver – as he/she open the driver's door – if the car lights have been left on. 'Lights-are-on' alarm units of this basic type are easy to build and are fairly easy to add to most older types of vehicle, and come in two basic types. Type-1 is for use in very old vehicles that are not fitted with a courtesy light that is switched automatically via a conventional door-activated microswitch, and Type-2 is for use in vehicles that are fitted with such a courtesy light system.

Figure 9 illustrates the basic operating principles of a Type-1 'lights-are-on' alarm circuit. Here, the actual alarm consists of a low-power 15 second buzzer or siren unit that has its supply lines wired in series with diode D1 so that current can only flow through the unit (and thus activate the buzzer/siren) when point-X is many-volts positive to point-Y, and in the diagram this situation only occurs when 'lights' switch S1 is in the ON (Side or Head) position and 'ignition' switch S2 is turned OFF. Thus, if the lights are left on, the alarm unit sounds-off as soon as the ignition is switched off, but mutes automatically after 15 seconds.

Figure 10 shows a simple but practical version of a Type-1 'lights-are-on' alarm unit. Here, Q1-Q2 are wired as a modified complementary astable multivibrator that has its power supplied via D1 and uses a 64R low-power speaker as the collector load of Q2, which is a 2N3704 type and has a peak collector current rating of 800mA. The astable's action is such that it generates a loud and fairly high alarm tone when power is initially applied, but the volume and frequency then decay steadily down to zero over a period of about 15 seconds. The decay time is controlled by R3-C2, and the initial frequency is controlled by R3-R4 and C1. To use the unit, simply connect its 'X' and 'Y' points in the way shown in Figure 9.

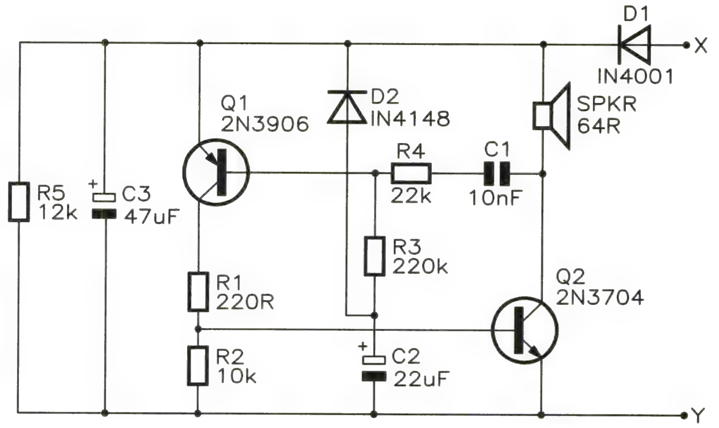


Figure 10. Practical Type-1 'lights-are-on' alarm unit.

Figure 11 illustrates the basic operating principles of the Type-2 lights-are-on alarm. It is similar to the Type-1 system, except that the alarm unit is wired between 'lights' switch S1 and dome-light-activating door-switch S2, so that the alarm only sounds if the lights are on when the driver's door is open.

The above Type-2 system is used on most modern vehicles, in which the dome light uses separate circuits for its 'courtesy' and 'reading' lights. A snag with most older vehicles is

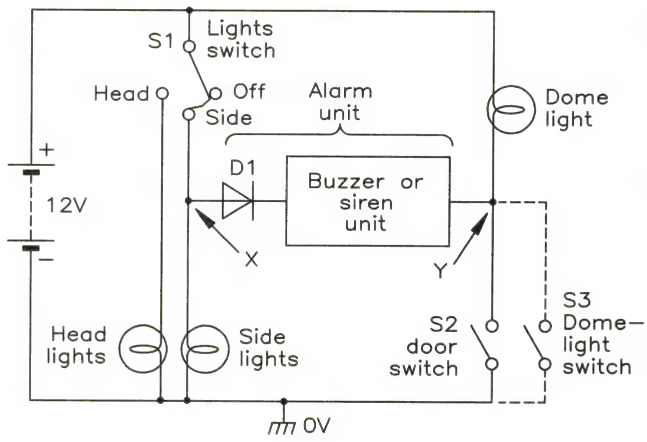


Figure 11. Basic Type-2 'lights-are-on' alarm circuit.

that they use a single light-bulb to perform both of these functions, with the 'reading' switch wired in parallel with S2, as shown by S3 in Figure 11, and as a consequence the alarm can be activated by either of these switches. The easiest way around this snag is to use an auto-turn-off alarm unit that, like the Type-1 unit, only sounds for a dozen or so seconds when activated. The alarm unit can thus take the simple 'monotone' form shown in the Figure 10, or can take the more attractive 'warble-tone' form shown in the Figure 12 circuit.

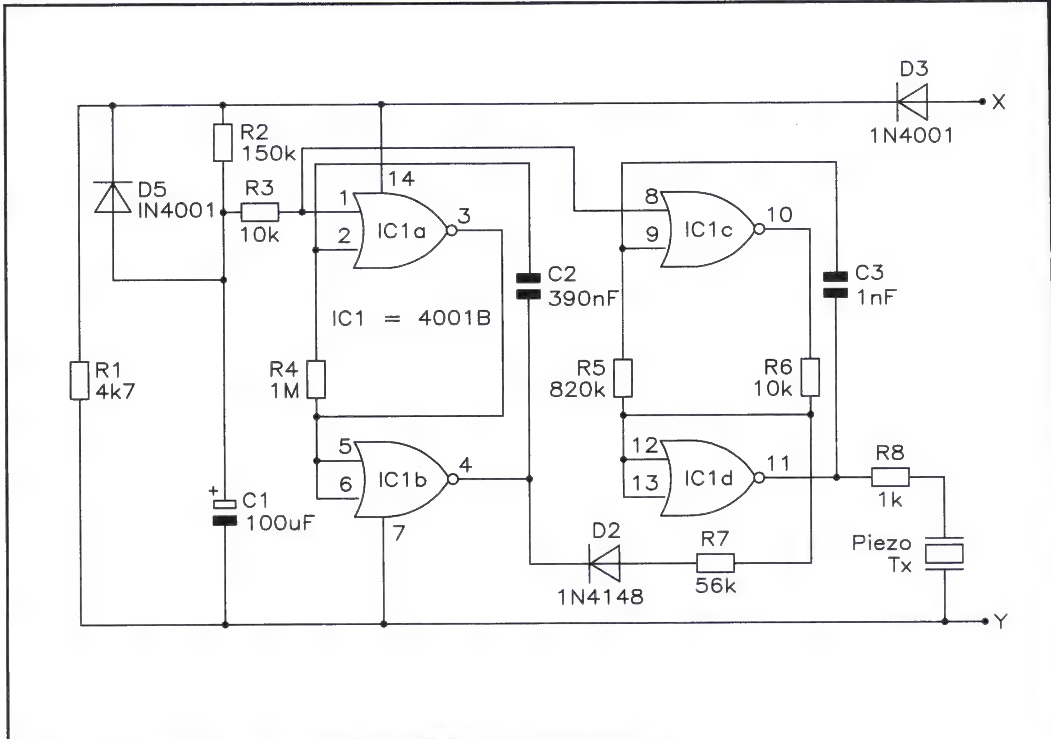


Figure 12. Practical warble-tone Type-2 'lights-are-on' alarm unit.

The Figure 12 circuit is based on warble-tone circuits shown in Part 3 of this series. In brief, IC1a-IC1b and R4-C2 are wired as a gated l.f. (low-frequency) astable and IC1c-IC1d and R5-C3 form a gated h.f (high-frequency) astable. Both astables are gated via the R2-C1 time-constant network, and are on when C1's output is below half-supply volts and off when C1's output is above half-supply volts. When the astables are gated on, the l.f. astable frequency-modulates the h.f astable (via D2-R7-R6), which has its output fed to piezo output transducer Tx via R8.

When power is connected to the Figure 12 circuit, C1 is initially fully discharged, so both astables are gated on and generate a warble-tone sound in the piezo Tx, However, C1 now charges up via R2 and after a delay of about 15 seconds (determined by R2-C1) gates both astables off, silencing the piezo Tx. When the unit's power connections are removed, C1 rapidly (in a second or so) discharges via D1-R1, and the unit is then ready to repeat its operating sequence when power is connected again.

A Headlight Time-Delay Switch

Headlight time-delay switches are simple add-on units that, when activated by a push switch, turn a car's headlights on for just a few minutes, during which the owner can leave and lock the vehicle, walk along a drive or pathway that is well lit by the headlights, and then enter the security of a safe building before the lights automatically turn off again. Figure 13 shows a practical transistor version of such a circuit.

In Figure 13, Q1 is an emitter follower that uses R3-R4 as its emitter load but has 'bootstrapped' resistor R2 wired between its base and emitter, so that R2's impedance – as seen from Q1's base – is many times greater than its dc resistance value. C1 and Q1's input impedance (which equals the parallel values of R2's impedance and Q1's base impedance) form a C-R time-constant network. The action of Q1 and this network is such that when power is first connected to the circuit, by briefly closing push-button switch S1, C1 is fully discharged and thus pulls Q1's base and emitter up to almost the full positive supply voltage, thus driving relay-activating common-emitter amplifier Q2 on via R3; as relay RLA turns on, contacts RLA/1 close and lock the supply on, and contacts RLA/2 close and turn the vehicle's headlights on.

As soon as power is connected to the circuit, C1 starts to charge up via the very high parallel impedances of R2 and Q2's base, and Q2's emitter voltage (and the current fed into Q2's base via R3) starts to decay exponentially until, after a delay of about two minutes. These values fall so low that RLA turns off, thus breaking the supply connection as RLA/1 opens and turning off the headlights as RLA/2 opens. C1 discharges rapidly via R1-D1 when the circuit's power connection is broken.

A Rear-Screen Heater Timer

Automobile rear-screen heaters draw typical operating currents of about 15A and so place a heavy strain on the vehicle's electrical generating system. If the heater is inadvertently left on for long periods, this strain can greatly reduce the generator's reliability and working life. Consequently, most modern automobiles are fitted with push-button operated rear-screen heater controllers that turn the heater off automatically after an operating period of about 16 minutes. Reliability-enhancing units of this basic type can easily be added to older vehicles, and – to conclude this series – Figure 14 shows a practical add-on circuit of this type.

The Figure 14 circuit incorporates a simple voltage regulator built around transistor Q1, a stable 16-minute timer

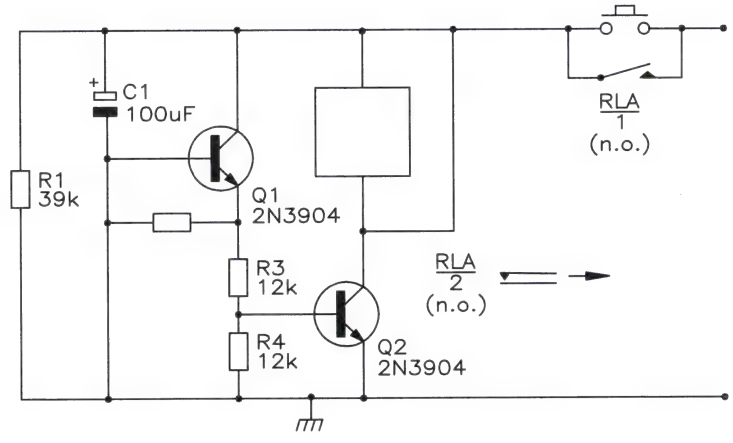


Figure 13. A headlight time-delay switch circuit.

ilt around IC1 and IC2, and lays RLA (which controls the rcuit's semi-latching function) d RLB (which controls the ar-screen heater's power ed), and derives its power ed via the vehicle's ignition itch. The complete circuit erates as follows.

The Figure 14 circuit is rned on by briefly closing ish-button switch S1. As S1 oses, the LED illuminates, a able 9.4V supply is applied to e IC1-IC2 timer circuit via Q1, d 'reset' pulses are fed to the 1a-IC1b bistable (via C2-R4) d the IC2 counter (via C4-8). As the bistable resets, its n-3 output flip high and turns RLA and RLB via Q2; as the lays turn on, the RLA/1 ntacts close, shunting S1 and cking-on the circuits supply nnection, and RLB/1 contacts ose and connect power to the ar-screen heater.

multaneously, as the IC1a-1b bistable resets, its pin-4 tput flips low and turns on e IC1c-IC1d gated astable, hich starts feeding clock ulses into pin-10 of the IC2 unter at an 8.5Hz rate.

xteen minutes later, in the rival of the astable's 8192nd ock pulse, the pin-3 output of 2 flips high and changes the ate of the IC1a-IC1b bistable, hich simultaneously gates off e astable and removes Q2's ase drive, thus turning off both lays; as RLA turns off it emoves the timer's supply onnection, and as RLB turns ff it removes power from the ear-screen heater.

Thus, when the vehicle's nition is turned on, the Figure 4 circuit connects power to e rear-screen heater as soon s S1 is closed, but removes it gain automatically after 16 inutes; if desired, the timing eriod can be ended prematurely y briefly closing S2, thus turning ff both relays. The circuit's ming period can, if you wish, e set to exactly 16-minutes by emporarily connected a LED nd 2k7 series resistor between ins 12 and 8 (0V) of IC2 and imming RV1 so that the LED perates with precise 30 second n and off periods.

When building this circuit, ote that RLA's contacts have to ass maximum currents of less han 200mA, and RLA can thus e almost any general-purpose elay, but that RLB's contacts ave to pass the full operating urrent of the rear-screen eater (typically 15A), and RLB ust thus be a dedicated heavy-uty 'automobile' relay.

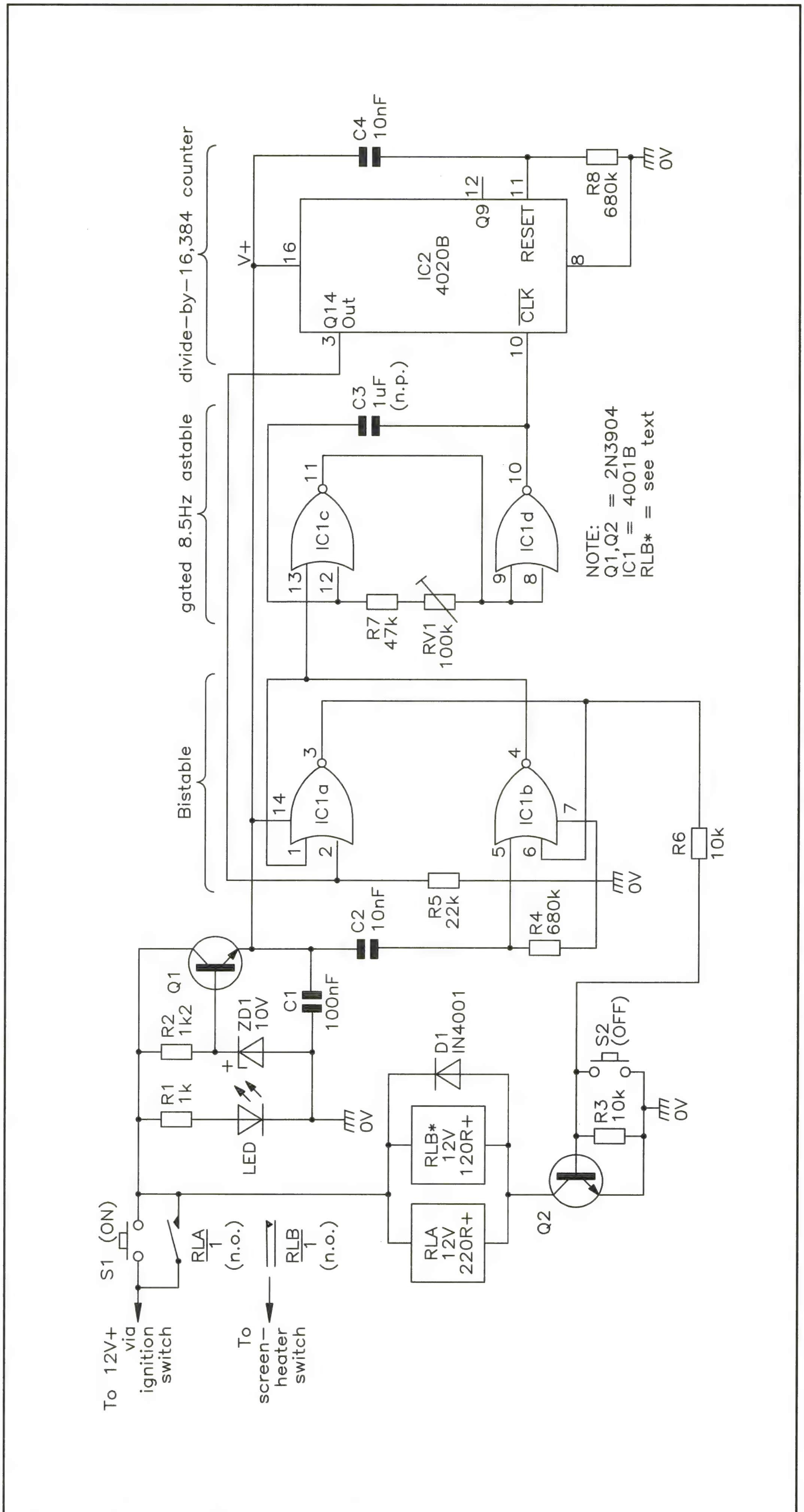


Figure 14. A rear-screen heater timer circuit.

TECHNOLOGY WATCH

with Martin Pipe

Not so long ago, paging was seen as a sickly child that would soon be killed off by cheap cellular. Then came services like CPP (calling party pays), and the industry has never looked back. Indeed, paging has been steadily growing in popularity worldwide. Well, I've seen the future of paging – if the EU don't put up a fight, that is. The big problem is that the technical standard that forms its basis, FLEX, is controlled by one company – Motorola, best known in the UK for its semiconductors and comprehensive range of mobile phones. Tying a paging standard to the whim of one organisation may be seen, not least by the EU, as anti-competitive. The paging standard currently in common use is known as POCSAG which was developed in the mid 1970s by the telecommunications arm of our own Post Office (which later became BT), it is at least an open standard.

POCSAG, now over 20 years old, is showing its age. It's inefficient in terms of radio spectrum. Basically, every message sent to a particular subscriber is transmitted by the entire network. It has to be; after all, that subscriber could be anywhere. The problem of wasted spectrum is big enough in the UK, but imagine what it's like in the somewhat bigger USA. All that wasted capacity adds up. When you consider that radio operating licenses increase in price at a greater rate than that of London housing, it becomes clear why paging operators would very much like an alternative.

POCSAG is also lacking in other areas. Although paging messages are more resilient than other forms of mobile communication – they will penetrate buildings, for example – there's no absolute guarantee that a message has been delivered. Operators could take the 'belt and braces' approach of re-transmitting the message at half-hour intervals for maybe a couple of hours, but it would add up to an organisational nightmare and much network congestion. Hardly surprisingly, few paging operators do it, and those that do charge more for their service.

POCSAG messages are transmitted in unencrypted ASCII, and can be accessed b anybody with access to a VHF/UHF scanne a PC, a simple level-shifter circuit and a MS-DOS computer program. The latter, an plans for the former, can be downloaded from at least one Internet site. Although subscribers might receive their messages i the belief that privacy is assured, nothing could be further from the truth. It's exacerbated by the fact that the same message is broadcast by paging transmitter across the country.

Communication across POCSAG network is fairly slow. 2400bps might have seemed positively space-age back in 1980, but now it's a restriction on the types of service that could be offered. Finally, POCSAG makes n concession to roaming. Unlike GSM phone you can't take your pager abroad and still receive messages from your folks back hom

The Motorola FLEX protocol, which was introduced commercially three years ago, addresses many of these issues. These include a faster data rate (up to 6400bps), better resilience to adverse radio conditions and better potential battery life (FLEX allows networks to specify how often the pager's R circuitry is powered to listen for data). At leas two UK paging networks – BT and PageOne have started introducing FLEX networks, presumably with an eye to the future.

A new derivative of the technology, known as ReFLEX, builds on the original standard with a radical improvement that overcomes POCSAG's spectral inefficiency and allows new services to be introduced. ReFLEX is the first paging technology in the world to allow two-way communication. Tw frequencies are allocated; one for transmission (outbound, or network-to-pager), the other for receiving responses (inbound, or pager-to-network). Each pager has a low-powered transmitter (1W or less) for sending data back to the network. That data could be a simple acknowledgement that a message has been received, or a complete e-mail message.

Both elements are attracting considerable interest in the USA, where commercial ReFLEX services have already started. mTel, a national paging operator in the States, still has a massive order backlog for the e-mail capable pagers. These $400 devices, made (surprise, surprise!) by Motorola, have a miniature QWERTY keypad so that e-mails – whether new ones or replies – can be composed. It's proper e-mail too; you can send and receive messages to and from anybody with an Internet connection. There is a restriction of 500 characters per outgoing message, but the Lilliputian keypad makes anything longer a tiresome task anyway. The system obstinately refuses to send messages of more than 500 characters, as I discovered the hard way...

Received messages can be any length, although mTel's TCP/IP-to-FLEX gateway ıtomatically strips off any file attachments. ney also have filters to eliminate junk e-ail. Just as well; the basic service ($25 per onth) gives you a total of 6000 characters r both send and receive; any more than is are charged at a cent each! As an ternative, there's a $99/month 60,000 haracter option.

At the time of writing, Motorola's two-way aging terminal – called PageWriter – is the ost portable way of remaining in contact ith the rest of the world via e-mail. It's far ss cumbersome than a notebook PC with djunctive mobile comms gadgetry, or even e Nokia Communicator (a digital mobile hone with in-built PDA). It's easier to use an the pager-style SMS (Short Message ervice) systems built into current GSM ellphones. PageWriter will interface to a Vindows 95 PC, via infra-red or RS232, so that ddress books and e-mail can be transferred. is claimed that the device will deliver a eek of average life on a single charge.

At a more basic level, mTel offer a uaranteed delivery' service, via a simpler 150 pager (also made by Motorola, though the American corporation says that ther manufacturers will be producing ompatible pagers and infrastructure quipment). In this case, the two-way nctionality is simply used to tell the perator that the message has been received y the subscriber's pager; if it hasn't (or its een garbled), it is re-sent until the cknowledgement is received. The service, vhich includes messages totalling 6000 haracters in length, costs $25 per month.

Interestingly, mTel's nearest POCSAG quivalent to this service – which doesn't have guaranteed delivery and only includes a monthly 5000 characters – is $50 per month. mTel is clearly trying to encourage subscribers to move to the new service. Why is this? It's because reFLEX is more spectrum-efficient, and the network is thus less expensive to run. Because the network knows where you are (it signals your pager nationally, and then uses the response to determine a fairly accurate geographic fix), it only has to transmit the message within a limited area. As a result, the network can accommodate more subscribers. There is also less chance of your messages from being intercepted (just as well, because FLEX doesn't yet support encryption).

Roaming across FLEX networks is also being investigated in Asia. The ReFLEX variant is essential here, otherwise spectrum would be wasted on an international scale! The biggest obstacle to ReFLEX roaming appears to be the variety of paging frequency allocations; a roaming pager would need a receiver and transmitter both capable of being tuned over an extended range. This means more complex circuitry, more cost and perhaps higher power consumption.

ReFLEX has other possibilities, and indeed Motorola is working on a machine-interfaceable ReFLEX paging receiver module that has RS232 and switched outputs. These could be built into all kinds of devices. If a vending machine was to run out of decaf, then the supplier would be paged for a refill. Building the device into a car has obvious security applications, but could also integrate with the diagnostics system. Dealers and service agencies could be warned of potential faults. Needless to say, only prestige vehicles would benefit initially.

One company is already offering a (one-way POCSAG) pager-based car security service in the US. It works with a Motorola OEM pager module, called the Creatalink, the switched outputs of which are hooked up to various systems in the car. Users ring up a phone number and select various options via DTMF. If you wake up one morning to discover that the vehicle has been stolen, its ignition can be remotely disabled so that it cannot be restarted. In addition, the doors can be unlocked (handy if you've lost your keys) or the alarm armed (if you've forgotten). Remote meter reading and home automation are other touted applications. The Creatalink isn't yet available in the UK, because our POCSAG frequencies differ from those used in the USA. A FLEX version is planned initially, to be followed by a ReFLEX model.

FLEX's current maximum outbound rate of 6400bps is only slightly faster than POCSAG. A recent development by Motorola, which is aimed at voice paging (effectively a portable answering machine), could, however, offer data transfer rates of up to 112kbps. inFLEXion, as the service is known, doesn't at the moment; subscriber's voice messages are currently sent to the pager in analogue (narrowband FM) form. It's definitely the way forward and, when combined with reFLEX's two-way advantages, could be used to provide fast Internet access. The reFLEX inbound path is, at 1200bps comparatively slow, but this need not be a problem. In most cases, this return path involves only page/file requests or outgoing e-mail messages (plain old ASCII text).

Using the Maplin CD-ROM CATALOGUE WITH WINDOWS 3.1/3.11

Those of you who still use older versions of Microsoft Windows may have been a little disappointed to find hat they couldn't run the free Maplin atalogue on CDROM on the cover of the pril issue of *Electronics and Beyond*.

The program makes use of some 32-bit oftware that just won't run under the Vindows 3.1 and 3.11 operating systems. Iowever, all is not lost. If you haven't used our free copy of our colourful CDROM as a risbee or as a coffee coaster yet, we have ood news for you!

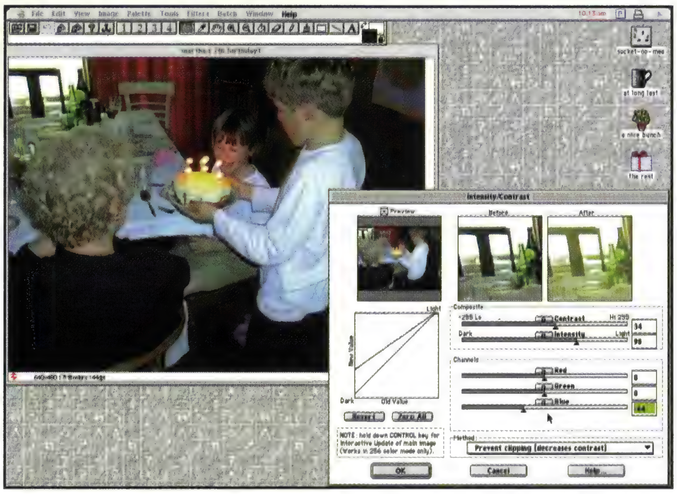
All you need to do in order to make your ystem capable of running our CD catalogue s to install Microsoft's very own set of 32-bit ile extensions on your system. These files re collectively called 'Win32s' and have een supplied on magazine cover disks for ome years now.

There is a slight catch. You can't install any old version of Win32s and expect our CD to run. It has to be the latest version (1.3). This has been around for a while now and is still being distributed on the CDs supplied with some PC magazines (April issue PC Direct, for example). If you are not sure which version of the Win32s files you have on your CDs, just run the setup program on the CD. The opening screen will tell you the version number. If it's version 1.25 or 1.2 or whatever, just cancel the installation as this won't help with our CD catalogue.

Once you have installed version 1.3 of Win32s (also provided with a 32-bit game to test the new 32-bit capability), you may reinstall our CD catalogue and it should run without problems. If you do run into any problems using the CD, refer to the FAQ's printed on page 73, issue 125, or look to our restyled web site on **`http://www.maplin.co.uk`** for more details of common questions and answers arising from use of our first CD catalogue.

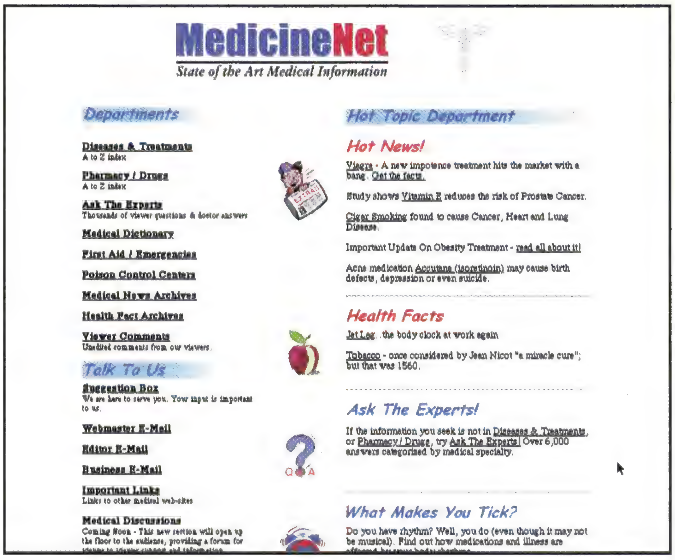
Please also note that by the time you read this, an updated version of the CD should be available, providing greater flexibility in installation to any drive/directory and allowing use with any CDROM drive letter up to and including letter Z.

Any customer wishing to upgrade their copy of the CDROM Catalogue to the latest version may download a patch program from the developers website on `http://www.matrixsoftware.co.uk`, but be warned that it is a long download.



NOTE: hold down CONTROL key for interactive Update of main image (Works in 256 color mode only).

Prevent clipping (decreases contrast)



MedicineNet

State of the Art Medical Information

Departments

Diseases & Treatments
A to Z index

Pharmacy / Drugs
A to Z index

Ask The Experts
Thousands of viewer questions & doctor answers

Medical Dictionary

First Aid / Emergencies

Poison Control Centers

Medical News Archives

Health Fact Archives

Viewer Comments
Unedited comments from our viewers.

Talk To Us

Suggestion Box
We are here to serve you. Your input is important to us.

Webmaster E-Mail

Editor E-Mail

Business E-Mail

Important Links
Links to other medical web-sites

Medical Discussions
Coming Soon - This new section will open up the floor to the audience, providing a forum for

Hot Topic Department

Hot News!

Viagra - A new impotence treatment hits the market with a bang. Get the facts.

Study shows Vitamin E reduces the risk of Prostate Cancer.

Cigar Smoking found to cause Cancer, Heart and Lung Disease.

Important Update On Obesity Treatment - read all about it!

Acne medication Accutane (isotretinoin) may cause birth defects, depression or even suicide.

Health Facts

Jet Lag...the body clock at work again

Tobacco - once considered by Jean Nicot "a miracle cure"; but that was 1560.

Ask The Experts!

If the information you seek is not in Diseases & Treatments, or Pharmacy / Drugs, try Ask The Experts! Over 6,000 answers categorized by medical specialty.

What Makes You Tick?

Do you have rhythm? Well, you do (even though it may not be musical). Find out how medications and illness are

Building a tower

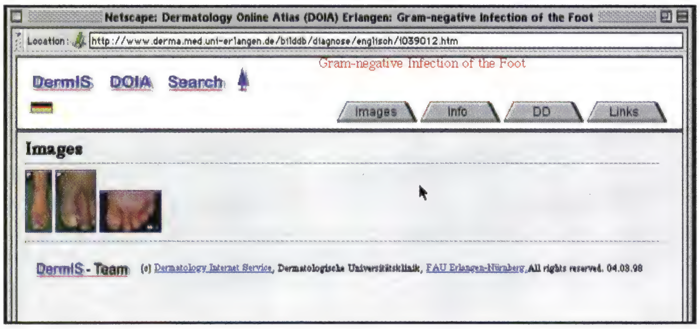
For graphics people who have to contend with receiving graphics files in weird and wonderful formats from other users, or for those who have to handle and reformat large batches of graphics, there's often only one choice of application. Equilibrium's DeBabilizer is usually the professional's choice. The latest update to DeBabilizer brings the program to version 3 and, hot off the press, we've taken it for a test drive.

Historically, DeBabilizer has always been a little tricky to get to grips with, being mostly dialogue box driven, but version 3 is much simpler to use. Its interface is now mainly graphical and menu-driven and with a much more modern feel. Drag-and-drop of files is supported into batch windows, and a host of new features expand its powers into full CMYK colour printing and expanded Web support. The dialogue boxes which you still need to use are much clearer than before.

Despite this greater ease of use, DeBabilizer has lost none of its inherent power. It can read, reformat and write from and to over 100 different graphics file formats either individually, or in batches, and graphics users of all categories will be pleased with the new version.

Medicine on the Web

The Internet opens up channels of knowledge to whoever wants to access that knowledge.



Netscape: Dermatology Online Atlas (DOIA) Erlangen: Gram-negative Infection of the Foot

Location: http://www.derma.med.uni-erlangen.de/bilddb/diagnose/englisch/1039012.htm

Gram-negative Infection of the Foot

Images

DermIS - Team (c) Dermatology Internet Service, Dermatologische Universitätsklinik, FAU Erlangen-Nürnberg. All rights reserved. 04.03.98

Traditionally, medicine is an area where the consumer (that is, the patient) is left out in the cold when it comes to understanding what medical condition ails them. Doctors, more often than not, talk gobbledegook, often seemingly in case the patient can understand them. Doctors tend to be a bit like IT departments in business – if the ordinary user can understand how to fix a computer, the IT department wouldn't be needed! Now at last, with the Internet, this needn't be the case.

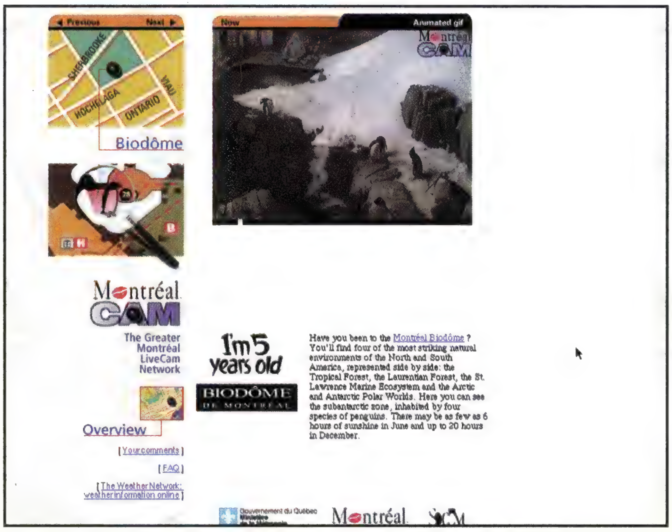
For consultations on the World Wide Web, there are several places to start. The Friedrich-Alexander-University of Erlangen-Nürnberg, School of Medicine, Department of Dermatology hosts the DermIS Dermatology Online Atlas at: <http://www.derma.med.uni-erlangen.de/bilddb/index_e.htm>. Here you'll find information about dermatological diseases and conditions you'll never have thought even existed. If you know the name of the condition you're wanting to look at, you'll also find, where applicable, pictures and differential diagnoses, so you can check for yourself what your diagnosis actually is, whether you feel it's correct, and what the prognosis is.

For a more general purpose virtual consultation, try MedicineNet's online information service at <http://www.medicinenet.com>. Here you'll find details of just about all diseases and treatments, a drugs database, a medical dictionary, as well as the ability to ask specific questions of a panel of medical experts.

Foreign (and chilly) parts

More and more museums, zoos and other public interest buildings are getting online. One of the most ambitious projects is Montreal's Biodôme, which incorporates complete areas of the North and South American continent's four main environments: a tropical forest, a Laurentian forest, a marine ecosystem, and arctic and antarctic polar worlds. The Biodôme's Web site is at <http://www.montrealcam.com/en-biodome-ag.htmal>.

Within the subantarctic zone of the arctic and antarctic worlds is positioned a camera, connected in real-time to the Biodôme Web site. From there, live on the Internet, you can view what's happening – complete with any of the animals in the zone which wander in front of the camera.



The Greater Montréal LiveCam Network

Have you been to the Montréal Biodôme ? You'll find four of the most striking natural environments of the North and South America, represented side by side: the Tropical Forest, the Laurentian Forest, the St. Lawrence Marine Ecosystem and the Arctic and Antarctic Polar Worlds. Here you can see the subantarctic zone, inhabited by four species of penguins. There may be as few as 6 hours of sunshine in June and up to 20 hours in December.

[Your comments]

[FAQ]

[The Weather Network: weather information online]

Gouvernement du Québec

Sifting Through Web Junk

The Web is an endless source of information, but with literally millions of pages posted by everyone from governments to universities and from sixth-formers to conspiracy theorists, it's getting harder and harder to find precisely the right information. Here Stephen Waddington discovers a new search technique that could simplify the task of searching the Web.

A Cornell University researcher has come up with a method of searching the Web that can return a list of the most valuable sites on a given topic, as well as a list of sites that index the subject. Early tests of the method have produced highly focused lists of sites on many topics, often comparable to lists carefully compiled by Web search experts.

The method was developed by Jon Kleinberg, Cornell professor of computer science. An evaluation of the method was presented at the seventh International World Wide Web Conference held during April in Brisbane, Australia, in a paper by Kleinberg, David Gibson of the Department of Computer Science, University of California at Berkeley, and several IBM researchers.

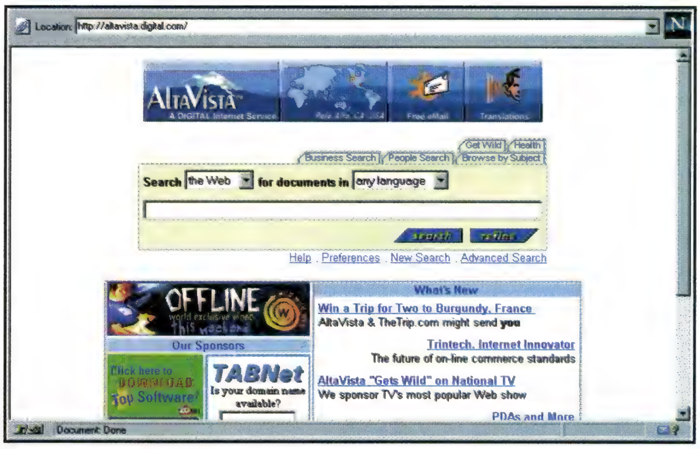
Mainstream Web Search Tools

Popular Web-searching tools, known as engines, such as Yahoo! and AltaVista, work by hunting for keywords in the text of Web pages. On some topics this can return hundreds or even thousands of pages. The algorithm developed by Kleinberg works by analysing the way Web pages are linked to one another. The assumption behind this is that the most authoritative pages on a given subject will be those that are most often pointed to by other pages.

Location: http://www.yahoo.com/

Yahoo! Chat with country music legend Willie Nelson, 6pm ET

YAHOO!
New
Cool
Today's News
More Yahoos
Yahoo! Mail
free email
keep in touch!
Download your Yahoo! Pager
Playoffs
NBA - NHL
Search
options
Yellow Pages - White Pages / People Search - Maps - Classifieds - Personals - Chat - Email
Shopping - My Yahoo! - News - Sports - Weather - Stock Quotes - more...
Arts and Humanities
Architecture, Photography, Literature...
News and Media [Xtra!]
Current Events, Magazines, TV, Newspapers...
Business and Economy [Xtra!]
Companies, Finance, Employment...
Recreation and Sports [Xtra!]
Sports, Games, Travel, Autos, Outdoors...
Computers and Internet [Xtra!]
Internet, WWW, Software, Multimedia...
Reference
Libraries, Dictionaries, Phone Numbers...
Education
Universities, K-12, College Entrance...
Regional
Countries, Regions, U.S. States...
Document: Done



Location: http://altavista.digital.com/

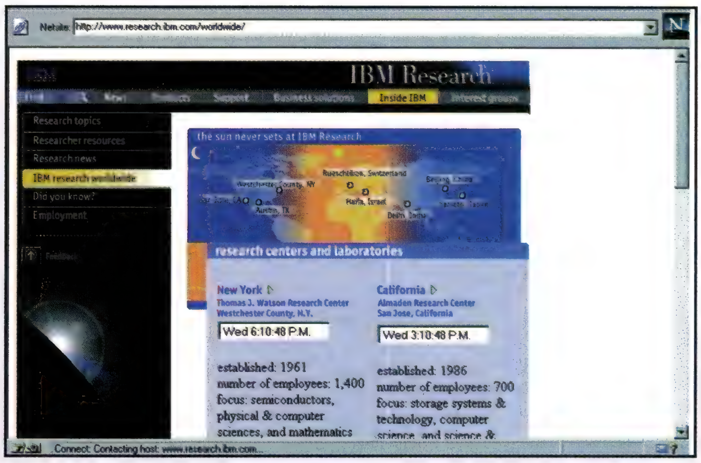
Search the Web for documents in any language

Win a Trip for Two to Burgundy, France
AltaVista & TheTrip.com might send you

Trintech, Internet Innovator
The future of on-line commerce standards

AltaVista "Gets Wild" on National TV
We sponsor TV's most popular Web show

AltaVista
A DIGITAL Internet Service
Free eMail
Translations
Get Wild
Health
Business Search
People Search
Browse by Subject
search
refine
Help . Preferences . New Search . Advanced Search
OFFLINE
world exclusive video this weekend
Our Sponsors
Click here to DOWNLOAD Top Software!
TABNet
Is your domain name available?
What's New
PDAs and More
Document: Done



Netsite: http://www.research.ibm.com/worldwide/

New York
Thomas J. Watson Research Center
Westchester County, N.Y.
Wed 6:10:48 P.M.
established: 1961
number of employees: 1,400
focus: semiconductors, physical & computer sciences, and mathematics

California
Almaden Research Center
San Jose, California
Wed 3:10:48 P.M.
established: 1986
number of employees: 700
focus: storage systems & technology, computer science, and science &

Connect: Contacting host: www.research.ibm.com...

Kleinberg claims that the Web is annotated with precisely the type of human judgment we need to identify authority. "It almost says something about the way the Web has evolved. I think it's about the way people link information in general, not just on the Web," said Kleinberg.

His method does more than just identify pages with useful information about a topic, which he calls 'authorities'. The method also looks for pages that contain many links to pages with useful information on the topic, which he calls 'hubs'.

The best authorities, Kleinberg says, will be those that point to the best hubs, and the best hubs will be the ones that point to the best authorities. Kleinberg prevents this from becoming a circular definition by recalculating the relationship several times, each time moving closer to the ideal result.

Fresh Approach

Kleinberg has written a search program using this technique called Hyperlink-Induced Topic Search (HITS). The technique begins by conducting an ordinary text-based search on a topic using a search engine such as AltaVista. This collects a 'root set' of about 200 pages that contain the entered keywords. It then expands the set to include all the pages linked to by pages in the root set. The expanded set might include from 1,000 to 3,000 pages.

From there on, text is ignored, and the application only looks at the way pages in the expanded set are linked to one another. The first time through, it identifies the pages that are pointed to most often by other pages, and assigns them a score, or 'weight', indicating that they are more likely to be authorities. At the same time it notes the pages that contain more links to other pages and gives them more weight as hubs.

This calculation is repeated several times. Each time the program gives more authority weight to sites that link to sites with more hub weight, and more hub weight to sites that link to sites with more authority weight. Ten repetitions, Kleinberg says, are enough to return surprisingly focused lists of authorities and hubs.

Benefits

The system overcomes several of the problems frequently identified with text-based searches. For example, at one time a text-based search for 'Gates' did not return the Microsoft home page because Microsoft chairman Bill Gates was not mentioned on the opening page. Meanwhile a search for 'jaguar' returns a jumble of pages about cars, animals and the obsolete but still much-discussed Atari Jaguar computer.

In a case where a word represents more than one topic, Kleinberg's method automatically separates sites into 'communities' of hubs and authorities, each representing one of the possible topics. Thus a HITS search on 'jaguar' lists first a community of sites related to the Jaguar computer, because the number of Web sites on this subject predominate. Further down, it listed communities relating to the football team and the car. Finally it finds sparse information relating to the animal, because this topic is simply not well represented on the Web, Kleinberg says.

Communities also form when a topic is polarised: A search on 'abortion' returns separate communities of pro-life and pro-choice sites, because the sites within each community link more densely to one another than to sites advocating an opposing view.

One disadvantage of the method, Kleinberg says, is that it doesn't always work for sharply focused queries. A search for 'Netscape 4.04', for example, returns a general list of sites about Web browsers.

More Information

Further information about Kleinberg's work can be found on his Web page at `www.cs.cornell.edu/home/kleinber` or `www.almaden.ibm.com/cs/k53/ir.html`. Kleinberg developed the method while working as a visiting scientist at IBM's Almaden Research Centre, on leave from Cornell. IBM has applied for a patent on the algorithm and is developing it further.

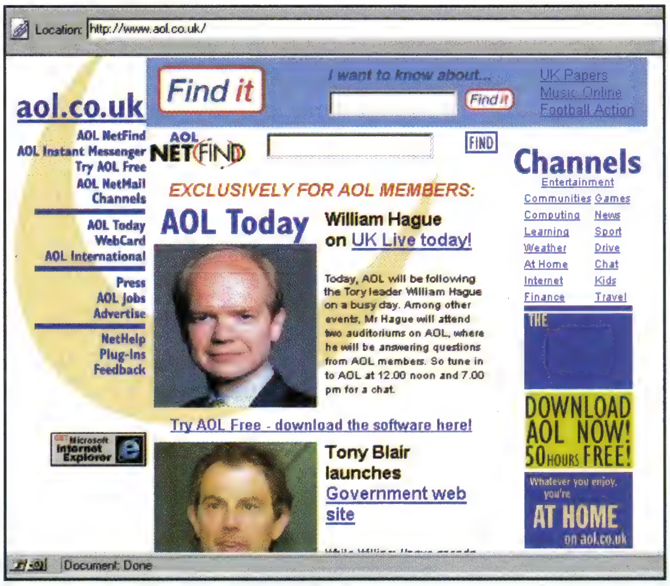
AOL UK Breaks 400,000 Barrier

Internet service provider AOL UK at **www.aol.co.uk** claims that it has reached over 400,000 members. Online usage sessions also continue to grow, with members spending an average of 10 hours per month and staying online for 20 minutes or more.

AOL UK's rising subscriber figures and usage patterns are also attracting many new content and advertising partners to the service. Recent content deals on the UK service include online news agency Out There News, Thomas Cook Online and listings guide This Is London. AOL UK claims that announcements in online banking and consumer motoring will follow soon.

The latest member milestone follows a new membership survey, which illustrates the changing profile of the online population. The rise in female subscribers to AOL UK shows no sign of slowing with women now representing 23% of all main account holders. The rise mirrors that in the US where a high percentage of all-new Internet and online content is aimed at women.

The survey also explodes some of the myths surrounding age profiles of AOL UK users with data showing that members aged 50 plus accounted for almost double the number aged 30 and below. With above average disposable incomes and more leisure time, the 'grey' market is set for a further surge in online usage according to AOL.



EXCLUSIVELY FOR AOL MEMBERS:

AOL Today

William Hague on UK Live today!

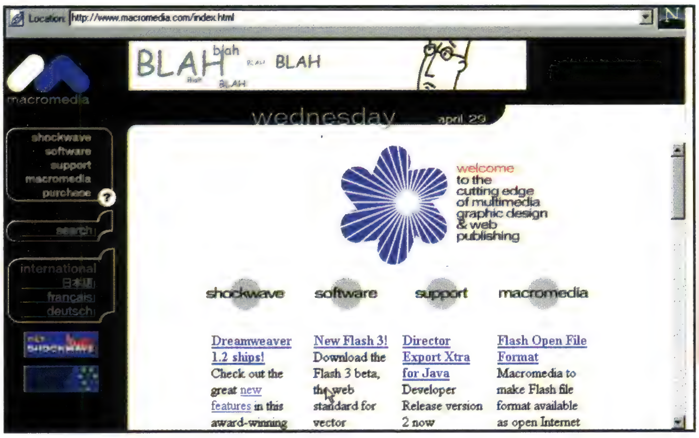
Today, AOL will be following the Tory leader William Hague on a busy day. Among other events, Mr Hague will attend two auditoriums on AOL, where he will be answering questions from AOL members. So tune in to AOL at 12.00 noon and 7.00 pm for a chat.

Try AOL Free - download the software here!

Tony Blair launches Government web site

Dreamweaver Delivers High-Impact Web Pages

Macromedia at **www.macromedia.com** has announced a new version of Dreamweaver, a visual tool for professional Web site design. Dreamweaver 1.2 enables web developers to deploy high-impact web pages over low-bandwidth Internet connections that take advantage of advanced Dynamic HTML features for users of 4.0 browsers, while maintaining compatibility with 3.0 browsers. This new release also includes several new enhancements that improve web developer productivity and enhance ease of use.



Dreamweaver 1.2 ships! Check out the great new features in this award-winning

New Flash 3! Download the Flash 3 beta, the web standard for vector

Director Export Xtra for Java Developer Release version 2 now

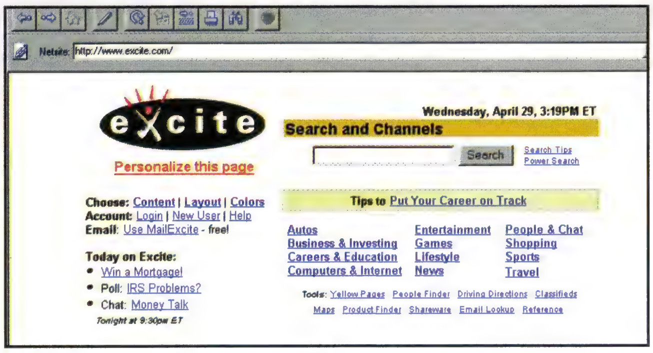
Flash Open File Format Macromedia to make Flash file format available as open Internet

Excite Targets Consumers with Personalised Web Page

Excite has converted its home page to a Web start page that can be uniquely created by each individual and tailored to their personal and local interests.

Excite's front page offers an interface that can be customised to deliver user-selected information such as news, weather, sports scores and daily horoscopes all at **www.excite.com.**

The site also offers individual services such as daily reminders, favourite columnists and personal shopping agents. Users can personalise all subjects, only the subjects in which they are interested, or just leave the page the way it is and enjoy Excite as they know it today. Once personalised, Excite will remember each person, and their interests, each time they come back.



Netsite: http://www.excite.com/
excite
Personalize this page
Wednesday, April 29, 3:19PM ET
Search and Channels
Search
Search Tips
Power Search
Tips to Put Your Career on Track
Autos
Business & Investing
Careers & Education
Computers & Internet
Entertainment
Games
Lifestyle
News
People & Chat
Shopping
Sports
Travel
Tools: Yellow Pages People Finder Driving Directions Classifieds
Maps Product Finder Shareware Email Lookup Reference

Choose: Content | Layout | Colors
Account: Login | New User | Help
Email: Use MailExcite - free!

Today on Excite:

- Win a Mortgage!
- Poll: IRS Problems?
- Chat: Money Talk

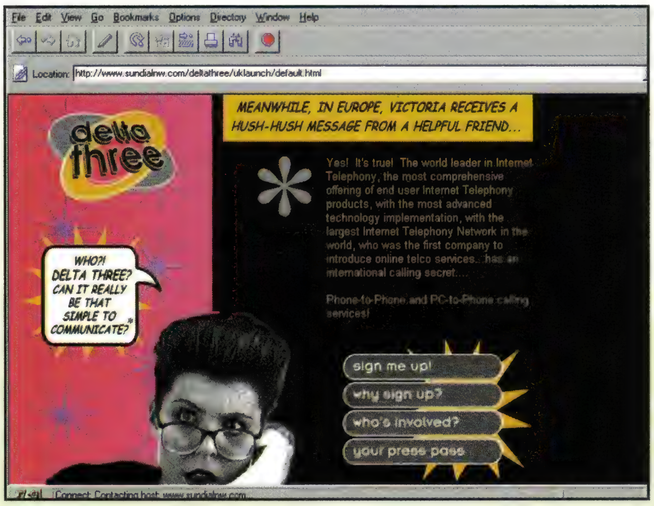
Tonight at 9:30pm ET

Delta Three Announce First Voice Over Internet Service

Delta Three has launched the first commercial Voice over the Internet aimed at telephone users. The services work in the same way as a traditional pre-paid card – except that the call uses the efficiency of Internet Protocol (IP) technology.

Examples of potential savings include rates of 36p to Argentina and Brazil, compared with BT's day-time rate of 131.85p.

Delta Three additionally offers a PC-to-Phone service which enables PC users to access over 240 countries via the Internet at dramatically reduced rates. Users can register for a Delta Three account at **www.deltathree.com/uk.**

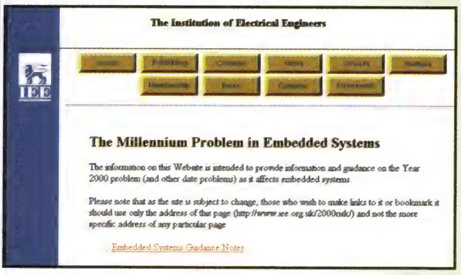


File Edit View Go Bookmarks Options Directory Window Help
Location: http://www.sundialnw.com/deltathree/uklaunch/default.html
delta three
MEANWHILE, IN EUROPE, VICTORIA RECEIVES A HUSH-HUSH MESSAGE FROM A HELPFUL FRIEND...
WHO?! DELTA THREE? CAN IT REALLY BE THAT SIMPLE TO COMMUNICATE?
sign me up!
why sign up?
who's involved?
your press pass
Connect: Contacting host: www.sundialnw.com...

Yes! It's true! The world leader in Internet Telephony, the most comprehensive offering of end user Internet Telephony products, with the most advanced technology implementation, with the largest Internet Telephony Network in the world, who was the first company to introduce online telco services... has an international calling secret...

Phone-to-Phone and PC-to-Phone calling services!

Year 2000: More Information from the IEE



The Institution of Electrical Engineers

The Millennium Problem in Embedded Systems

The information on this Website is intended to provide information and guidance on the Year 2000 problem (and other date problems) as it affects embedded systems.

Please note that as the site is subject to change, those who wish to make links to it or bookmark it should use only the address of this page (http://www.iee.org.uk/2000risk/) and not the more specific address of any particular page

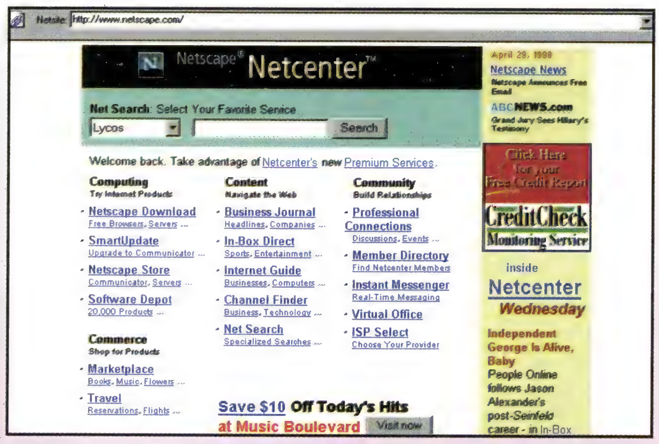
The IEE has published Addenda to its 'Guidance Notes on Embedded Systems and the Year 2000 Problem'. The Addenda is now available, both on the IEE Web site at **www.iee.org.uk/2000risk** and in printed form.

The Addenda includes a new section on Risk, which one major company already proposes to use as the backbone of its Year 2000 programme. There is a further, and much longer, list of problem dates, which starts with the (non-existent) Year 0. There is an updated list of useful Web sites, all accessible from the IEE's own site.

A new section identifies 10 'technological viewpoints' from which embedded systems may be approached. This information will help companies decide on the approach they should take to the problems and/or who within the company shop.

Netscape Set to Challenge Yahoo! And Excite

Netscape is planning to develop its Netcenter Web site at www.netscape.com into an Internet gateway similar to Yahoo! and Excite, and offer free e-mail. Netscape will use its position as the dominant browser maker, with 70 million users, to attract traffic to Netcenter.



Netsite: http://www.netscape.com/

Welcome back. Take advantage of Netcenter's new Premium Services.

Spam Fritters Away £5billion

Location: http://www.novell.com/corp/intl/uk/

Novell UK and Ireland

IS YOUR NETWORK READY FOR THE YEAR 2000 ?

Product of the Year. Innovation of the Year. Network Hall of Fame. The awards are already stacking up for Novell and its products. Read all about the honours Novell has earned so far in 1998.

Junk e-mails is costing UK businesses £5 billion a year and threaten to severely affect the Internet's progress as the business medium, according to research from Novell at **www.novell.com**. The survey also found that amongst people who had received repeat spam there was a worrying incidence of those that had received e-mails of a sinister or offensive nature, otherwise known as 'cyber-stalking'. The report, entitled 'A Spammer in the Works', found that 75% of the people surveyed receive up to five spam e-mails a day, with a further 16% receiving between six and 25 spam e-mails a day. In dealing with these e-mails, 75% said they wasted up to 15 minutes a day reading, deleting, filing or responding to spam and an amazing 15% wasted an hour doing the same. Taking the working population as a whole, this means that the amount of time being wasted dealing with spam e-mails each year in the UK equates to over £5.1 billion.

As well as costing businesses money, spamming is negating the efficiency savings brought by the Internet and e-mail, with a resulting 47% of people believing that the spam problem has reached levels of seriousness which could lead to people being driven away from using the Internet and e-mail. Spam can range from the relatively harmless 'junk' office broadcasts to product promotions, pornographic material and 'cyber-stalking', where individuals are literally 'stalked' by an unknown but persistent spammer

Online Shopper Choose from 200,000 Music Titles

Following a deal between AOL and music retailer N2K, AOL UK members have access to N2K's complete range of discounted CDs.

Under the agreement, N2K and the AOL services in Europe will create co-branded versions of the local-language Music Boulevard online music superstore, which will be integrated into the local services and available to AOL members in Europe and Web users visiting the relevant home pages.

For example, members of the AOL UK service will have access to the English version of the co-branded store, and Web users in the UK can visit **www.aol.co.uk**.

Post Office and MSN Turn E-Mail into Real Mail

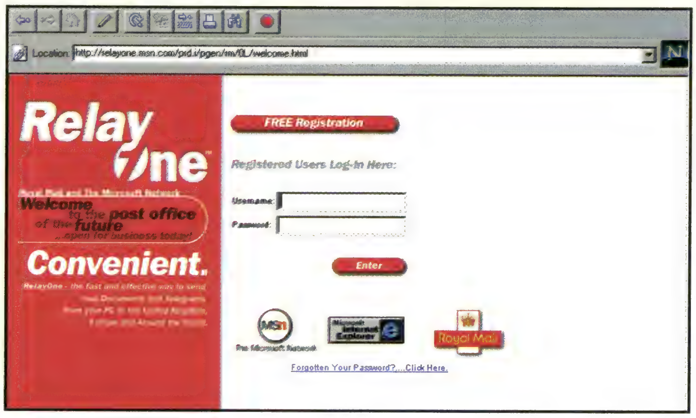
RelayOne, launched by Royal Mail and the Microsoft Network, enables e-mail users to reach people within Europe who are either not online, or who require hard copies of letters, documents and presentations.

To use the service, consumers simply enter the RelayOne at **www.msn.co.uk** site and register to use the service by entering personalised information.

To send a letter users enter the recipient's address and a message. For a longer document, you simply print to the RelayOne 'printer' in the same way that you select a real printer within your chosen application.

The Microsoft Network transmits the information over the Internet to Royal Mail's Electronic Services Centre in London, where it is printed, enveloped and despatched by first class mail within the UK, or by international airmail for delivery outside of the UK.

The cost of sending a one-page letter e-mailed from anywhere in the world to any address in the world is £1.50. The charge for sending four pages is £3.00, while a document of up to 50 pages costs £5.00 in Europe and £10.00 for the rest of the world. All payments are made by credit card.

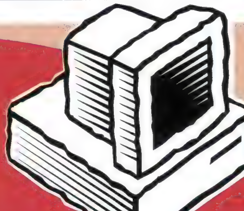


Location: http://relayone.msn.com/prd.i/pgen/rm/0L/welcome.html

Welcome to the post office of the future ...open for business today!

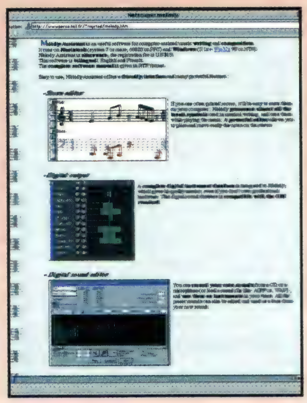
RelayOne™
Royal Mail and The Microsoft Network
Convenient.
FREE Registration
Registered Users Log-in Here:
Username:
Password:
Enter
MSN
The Microsoft Network
Microsoft Internet Explorer
Royal Mail
Forgotten Your Password?....Click Here.

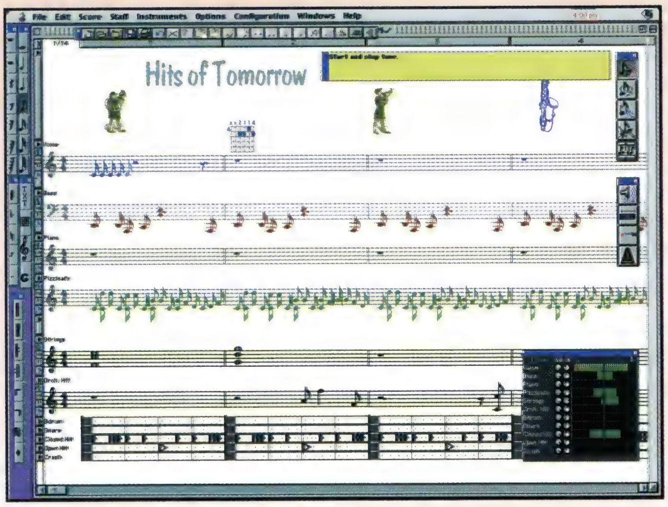
Site Survey



The month's destinations

If music be the food of love, play on. Well,now at least you can do it on your personal computer if you checkout **<http://members.aol.com/gbshare>** where you'll find details of how to get to Didier and Olivier Guillion's Website, from where you can download their fabulous shareware program called Melody Assistant. While shareware, this program allows you to compose and play music on your computer – working in sheet music mode to do both. Songs can be imported from and exported to many other formats, including midi, karaoke and band in a box styles. It comes with a midi database of musical instruments, so that you can specify whatever instrument you want to a staff. Incredible fun. Incredible value. Melody Assistant is available for both Mac and PC.




File Edit Score Staff Instruments Options Configuration Windows Help
Hits of Tomorrow
Start and stop here

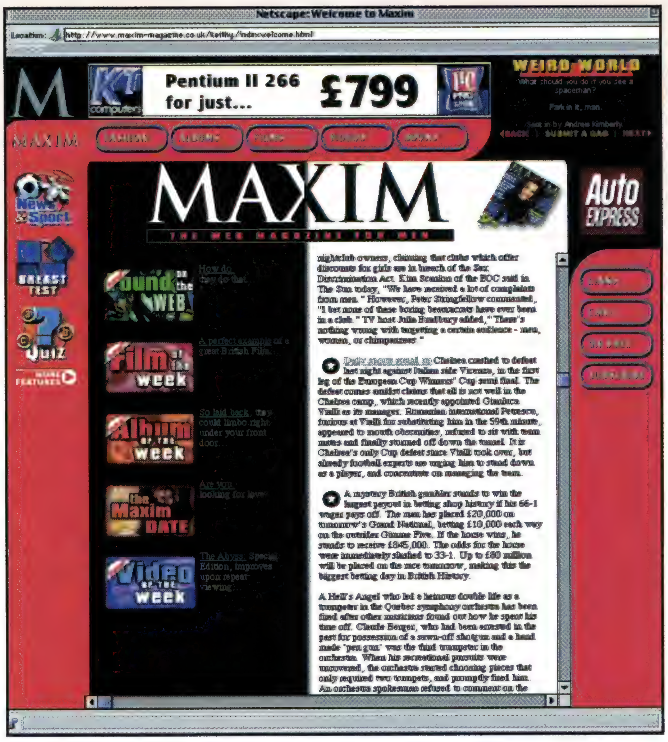
Mailing lists are an exciting way of keeping in touch with others of similar interests. They are run by individuals who collect together incoming mail and resend this back out to all members of the list. In this way, people can signup to receive a list, send mail to it knowing that everyone else on the list will see it, read all the mail sent by others, replying if they want. Even if you never actually make a posting to a mailing list you're subscribed to, lurking on a list (that is, just reading all the correspondence on the list) is an ideal way of keeping in touch with trends. There are literally thousands of mailing lists (at least one on just about every possible aspect you might want) and locating one that interests you can be a major headache. Point your Web browser to **<http://www.neosoft.com/internet/paml/bysubj.html>** where you'll find the Mother of all list of lists. The Publicly Accessible Mailing Lists Website is maintained to help everyone find a list that interests them.

Netscape: Publicly Accessible Mailing Lists -- Index by Subject
Location: http://www.neosoft.com/internet/paml/bysubj.html
How big is your conference table?
Publicly Accessible Mailing Lists
Subjects

Singapore is on the way up Mount Everest, and has a Website at **<http://www.everest.org.sg/>**. From there you can get full details and pictures of the ascent, as well as read dispatches, download QuickTime virtual reality movies, and even send messages to the team.

Netscape: First Singapore Mount Everest Expedition 1998
Everest Base Camp, 5,400m
Exhibition at the Science Centre

OK, we've got our Men Behaving Badly t-shirts on now, so ladies turn their heads, while laddish culture prevails. Maxim magazine has just opened its Website up, at **<http://www.maxim-magazine.co.uk>**, where you'll find some 2,000 pages or so of news, sport, games, beautiful women, fashion, movie reviews, guides to the coolest alternative men's sites, loads of interactive games and more. You can test your chatting up technique in Maxim's virtual bar, you can find out what women really think of men in our interactive powder room, and you can even build your own virtual dream girl in our interactive sex survey. Doesn't that make you feel proud to be a man? Sorry gals, I meant a male gendered individual (just joking, honest!).



nightclub owners, claiming that clubs which offer discounts for girls are in breach of the Sex Discrimination Act. Kim Stanlon of the EOC said in The Sun today, "We have received a lot of complaints from men." However, Peter Stringfellow commented, "I bet none of these boring beauracrats have ever been in a club." TV host Julia Bradbury added, "There's nothing wrong with targetting a certain audience - men, women, or chimpanzees."

Daily sports round up Chelsea crashed to defeat last night against Italian side Vicenza, in the first leg of the European Cup Winners' Cup semi final. The defeat comes amidst claims that all is not well in the Chelsea camp, which recently appointed Gianluca Vialli as its manager. Romanian international Petrescu, furious at Vialli for substituting him in the 59th minute, appeared to mouth obscenities, refused to sit with team mates and finally stormed off down the tunnel. It is Chelsea's only Cup defeat since Vialli took over, but already football experts are urging him to stand down as a player, and concentrate on managing the team.

A mystery British gambler stands to win the largest payout in betting shop history if his 66-1 wager pays off. The man has placed £20,000 on tomorrow's Grand National, betting £10,000 each way on the outsider Gimme Five. If the horse wins, he stands to receive £845,000. The odds for the horse were immediately slashed to 33-1. Up to £80 million will be placed on the race tomorrow, making this the biggest betting day in British History.

A Hell's Angel who led a heinous double life as a trumpeter in the Quebec symphony orchestra has been fired after other musicians found out how he spent his time off. Claude Berger, who had been arrested in the past for possession of a sawn-off shotgun and a hand made "pen gun" was the third trumpeter in the orchestra. When his recreational pursuits were uncovered, the orchestra started choosing pieces that only required two trumpets, and promptly fired him. An orchestra spokesman refused to comment on the

in the pipeline

ELECTRONICS and Beyond

Don't miss another great assortment of entertaining and easy-to-make projects and essential electronics information aimed at the novice constructor.

Issue 128 on sale Friday 3rd July

PROJECTS

418MHz Transmitter/Receiver Module Applications

Building & Upgrading PCs - *Part 5*

Troubleshooting

Centronic Data Logger

FEATURES

Imaging Devices - *From Film & Video to Positron Emission Tomography*

Radiation - *Measurements*

Driving Serial EEPROMs

AVR Microcontrollers - *Designers Notebook*

Spreadsheets - *Part 2*

Words of Science - *Science, the Lifeblood of Language*

Iomega - *Removable Data Storage*

Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:

PROJECT RATING 1	Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.
PROJECT RATING 2	Easy to build, but not suitable for absolute beginners. Some test gear (e.g. multimeter) may be required, and may also need setting-up or testing.
PROJECT RATING 3	Average. Some skill in construction or more extensive setting-up required.
PROJECT RATING 4	Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.
PROJECT RATING 5	Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

Ordering Information

Kits, components and products stocked at Maplin can be easily obtained in a number of ways: ❶ Visit your local Maplin store, where you will find a wide range of electronic products. If you do not know where your nearest store is, telephone (01702) 554002. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance; ❷ Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Payment can be made using Cheque, Postal Order, or Credit Card; ❸ Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554000; ❹ If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply dialling (01702) 552941. If you do not have a customer number, telephone (01702) 554002 and we will happily issue you with one. Payment can be made by credit card; ❺ If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place your orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 556751. You will need a Maplin customer number and a personal identification number (PIN) to access the system; ❻ Overseas customers can place orders through Maplin Export, P.O. Box 777, Rayleigh, Essex SS6 8LU, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 554001. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

Internet

You can contact Maplin Electronics via e-mail at `<recipient>@maplin.co.uk` or visit the Maplin web site at `http://www.maplin.co.uk`.

Prices

Prices of products and services available from Maplin shown in this issue, include VAT at 17·5% (except items marked NV which are rated at 0%). Prices are valid until 31st July (errors and omissions excluded). Prices shown do not include mail order postage and handling charges. Please add £2.95 to all UK orders under £30.00. Orders over £30.00 and MPS Account Holding customers are exempt from carriage charges.

Technical Enquires

If you have a technical enquiry relating to Maplin projects, components and products featured in *Electronics and Beyond*, the Technical Sales Dept. may be able to help. You can obtain help in several ways: ❶ Over the phone, telephone (01702) 556001 between 9.00am and 5.30pm Monday to Friday, except public holidays; ❷ By sending a facsimile, Fax (01702) 554001; ❸ Or by writing to Technical Sales, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Sales are unable to answer enquires relating to third-party products or components which are not stocked by Maplin.

Maplin 'Get You Working' Service

If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker ideas; Mini-Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (minimum £17) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts.

Win One of these Fabulous Prizes Every Month

Just take out or renew a subscription for 12 issues of

ELECTRONICS and Beyond

and your name will be entered into the draw, but hurry the final date for names to go into the hat is 31st July 1998.

**Two winners will receive a prize each month.*

Call the Subscription Hotline on 01702 554155 (ext 311)

HOW TO ORDER

Simply fill in the details and send your completed subscription form to: Electronics and Beyond Subscriptions,
Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex SS6 8LU

PAYMENT BY CREDIT CARD

☐ I wish to pay by CREDIT CARD, Please debit my account.

I wish to pay by:

☐ MasterCard ☐ Visa ☐ American Express ☐ Switch Issue no——

Card Number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ Expiry Date ☐☐/☐☐

Signature ____________ Date ____________

PAYMENT BY CHEQUE

☐ I wish to pay by cheque made payable to **Maplin Electronics.**

PLEASE TICK THE SUBSCRIPTION YOU REQUIRE

☐ Yes, I'd like to subscribe to Electronics and Beyond. Please start my subscription with the next issue.

☐ I am an existing subscriber, please extend my subscription.

☐ UK £28.20

☐ Eire, Europe Airmail and Surface Mail outside Europe £40.00 (or 94 IRCs)

☐ Airmail outside Europe £51.50 (or 120 IRCs)

DELIVERY DETAILS

Mr/Mrs/Ms ____________

Address ____________

____

Postcode ____________

Daytime Telephone Number ____________

Please tick your first choice ☐ Zip Drive ☐ Sc

Note that the model available at the time of the draw will be s
or an alternative prize of equivalent value will be substituted.

ELECTRONICS and Beyond

SUBSCRIBER'S SPECIAL OFFERS

SUBSCRIBE TODAY AND QUALIFY FOR THESE AMAZING SAVINGS!

HURRY! OFFERS OPEN FROM 27th MAY TO 31st JULY

AUTO REAR WINDOW WIPER

CATALOGUE PRICE £12.99

SUBSCRIBERS' PRICE £9.99

SAVE £3

Code 53737

CONTINUITY TESTER KIT

CATALOGUE PRICE £14.99

SUBSCRIBERS' PRICE £9.99

SAVE £5

Code 53736

MULTI STROBE SEQUENCER

CATALOGUE PRICE £149.99

SUBSCRIBERS' PRICE £109.99

SAVE £40

Code 53738

WINDOW DEMISTER AERIAL

CATALOGUE PRICE £19.99

SUBSCRIBERS' PRICE £16.99

SAVE £3

Code 53739

NURSE CALL RX KIT

CATALOGUE PRICE £49.99

SUBSCRIBERS' PRICE £22.99

SAVE £27

Code 53741

NURSE CALL TX KIT

CATALOGUE PRICE £39.99

SUBSCRIBERS' PRICE £22.99

SAVE £17

Code 53740

As a fully paid-up subscriber you can use the special Subscriber-only order codes and save up to 34%

When ordering any of these special offers which apply only for Subscribers and new Subscribers of *Electronics and Beyond*, please quote your Subscribers' Membership number (telephone Customer Services on 01702 554002 if not sure) and the special order code number. All items are subject to availablility. Prices include VAT. Catalogue prices refer to the 1998 Maplin Electronics Catalogue. Overseas subscribers telephone +44 1702 554000 Ext. 326 for carriage charges. A £3.95 Carriage Charge will apply to all UK orders under £30.00 (Maplin Electronics Account Holding Customers exempt).

telephone 01702 554000 for your copy of the 1998 Maplin catalogue

the new **Maplin** catalogue...

in touch

with **your** needs

NOW AVAILABLE ON CD ROM

- **Includes over 400 Data Sheets**
- **Prepare your order online**
- **Order code CQ01**

MAPLIN ELECTRONICS
the complete cd catalogue for electronics
1998
MARCH 98 - AUGUST 98
RS 12750 STOCKHOLDING & SUPPLY
48 STORES NATIONWIDE & OVER 1000 NEW PRODUCTS
visit our Web Site http://www.maplin.co.uk
MAPLIN ELECTRONICS
01702 554000
the complete catalogue for electronics march 98 - aug 98
1998
electronics and beyond
visit our Web Site http://www.maplin.co.uk

MORE PRODUCTS! MORE FUN!

There's over 22,000 products from modules and kits to electronic parts and components. You can order by telephone 24 hours a day or visit one of our 48 stores nationwide. At Maplin we offer same day despatch and free delivery on orders over £30 (including VAT).

Order your catalogue now on **01702 554000**. The catalogue costs just £3.99 plus p+p* and the CD Rom is available at just £1.95 plus p+p*. You can also purchase your copy from your local Maplin store, WH Smith and John Menzies.

- **Over 1,000 new products**
- **Includes over £50 worth of discount vouchers**
- **Order code CA17**

*(Add 50p for P&P). Orders outside the UK please send £8.99 or 21 IRCs for Airmail in Europe or surface mail outside Europe. Send £16.04 or 37 IRCs for Airmail outside Europe to: Maplin Electronics, PO Box 777, Rayleigh, Essex, England, SS6 8LU. Prices include VAT and are subject to change. All items subject to availability. E+OE. **WHEN ORDERING PLEASE QUOTE PRIORITY CODE** MA058